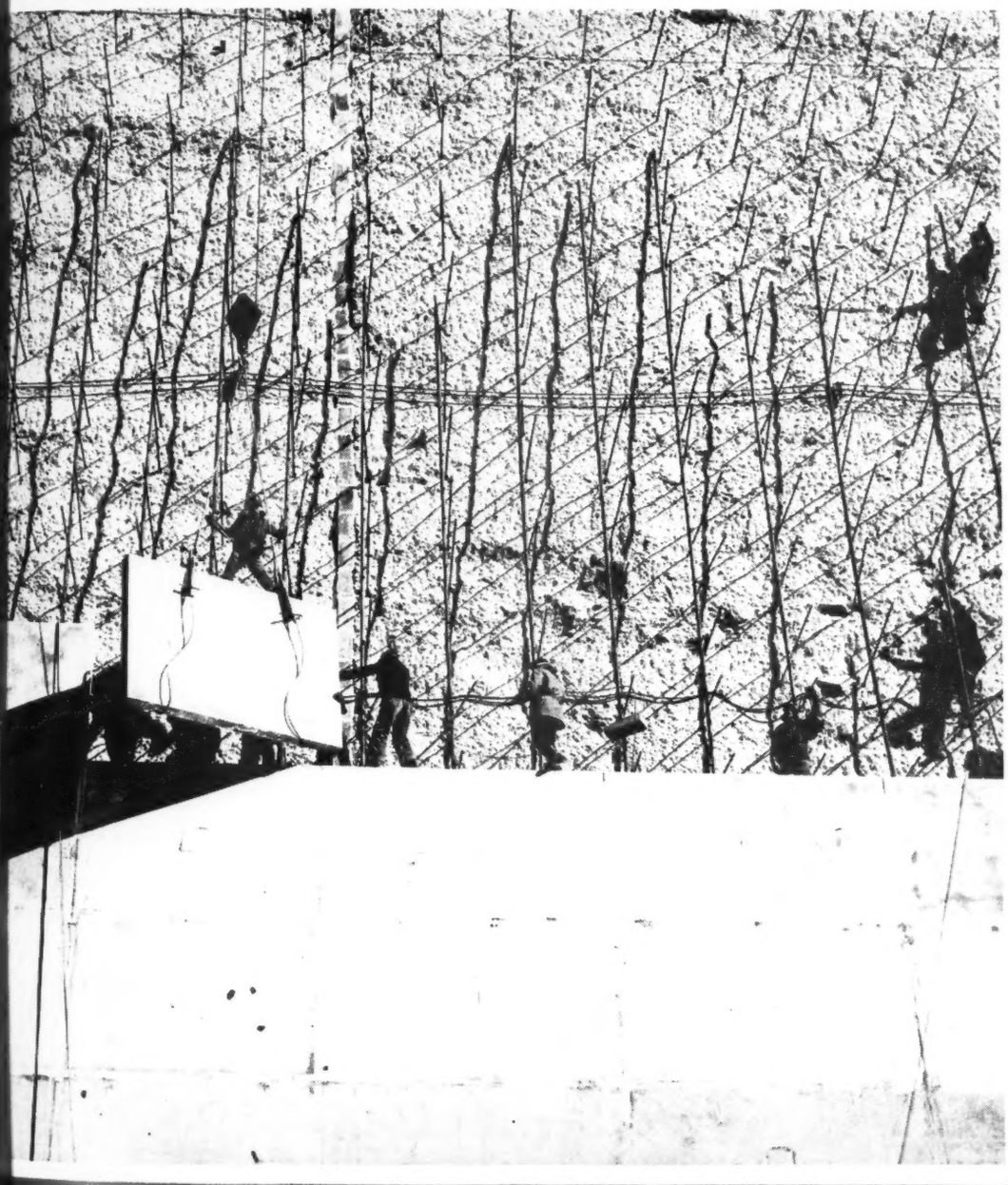
ENGINEERING
LIBRARY

MAY 21 1947

Compressed Air Magazine

MAY 1947



REFACING POWER DAM IN COLORADO

Setting precast concrete slab in wall as one step in unique restoration job

(See page 113)

VOLUME 52 • NUMBER 5 NEW YORK • LONDON

HIGHER efficiency and greater economy in compressor operation – you get both when you lubricate with *Texaco*. Just use the *Texaco Alcaid, Algol or Ursa Oil* recommended for the size and type of your compressors and operating conditions.

Texaco Alcaid, Algol and Ursa Oils are all made from carefully selected base stocks, specially refined to remove impurities that cause gum formations and hard carbon deposits. Thus, they keep valves "clean as a whistle" . . . rings free . . . ports and air lines clear. Your compressors deliver full air pressure, require less servicing, cost less to operate.

Also important: You get prompt action when you order Texaco Products or call on Texaco Lubrication Engineering Service. The nearest of the more than 2500 Texaco distributing plants in the 48 States is ready to supply you. Or write The Texas Company, 135 East 42nd Street, New York 17, New York.

KEEP DRILLS *ON THE JOB*

Texaco Rock Drill Lubricants (E.P.) increase operating efficiency, prevent rust, reduce out-of-service time for repairs, assure longer drill life. Their "extreme pressure" characteristics protect moving parts even in the heaviest service. All meet the exacting specifications set by leading rock drill manufacturers.

TEXACO

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

Tune in . . . TEXACO STAR THEATRE presents the NEW TONY MARTIN SHOW every Sunday night. See newspaper for time and station.

Compressed Air Magazine

COPYRIGHT 1947 BY COMPRESSED AIR MAGAZINE COMPANY

VOLUME 52 **May, 1947** NUMBER 5

G. W. MORRISON, *Publisher*

C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Advertising Mgr.*
A. W. LOOMIS, *Assistant Editor* DON J. MAREK, *Advertising Sales*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E.C., 4.
F. A. McLEAN, *Canada*, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

Cleaning Boiler Heating Surfaces 108
Unique Methods Used to Restore Old Power Dam 113
Houses Built of Earth—*Mat Kauten* 117
New Uses for Desert Plants—*Fremont Kutnewsky* 121
Loading Industrial Machinery Pneumatically 124
Mobile Drill Sled for Slope Quarrying—*W. C. Coe* 126
Exploding Cereals with Compressed Air 128
This and That 129
Editorials—Health in Industry—Paper-Making Milestone 130
Airplane Landing Gear with Pneumatic Cushioning Unit 131
Tube Both Heats and Cools Air 131
Industrial Notes 132

ADVERTISING INDEX

Air-Maze Corp. 30
Allis-Chalmers Co. 11
Bethlehem Steel Co. 14
Black, Sivalls & Bryson, Inc. 24
Bucyrus-Erie Co. 8
Conrader Co., R. 30
Cook Mfg. Co., C. Lee 12
Crane Co. 16
Cuno Engineering Corp. 15
Dollinger Corp. 3
Eimco Corp., The 7
Electric Machinery Mfg. Co. 10
Fairbanks Co., The 5
Galland-Henning Mfg. Co. 26
Goodall Rubber Co., Inc. 26
Houghton & Co., E. F. 13
Industrial Clutch Corp. 23
Ingersoll-Rand Co. 4, 17, 22, 27
Leavitt Machine Co., The 28
Maxim Silencer Co., The 28
National Forge & Ordnance Co. 9
Naylor Pipe Co. 19
New Jersey Meter Co. 24
Nicholson & Co., W. H. 29
Norgren Co., C. A. 28
Norton Co. 18
Roebling's Sons Co., John A. 31
Rhoads & Sons, J. E. ..... 3rd Cover
Schieren Co., Chas. A. 29
Socony-Vacuum Oil Co., Inc. ..... 4th Cover
Square D Co. 26
Terry Steam Turbine Co., The 21
Texas Co., The ..... 2nd Cover
Timken Roller Bearing Co., The 32
Van Products Co. 30
Victaulic Co. of America 20
Vogt Machine Co., Inc., Henry 6
Walworth Co. 25
Wisconsin Motor Corp. 29

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit

Published by Compressed Air Magazine Co., G. W. MORRISON, *President*; C. H. VIVIAN, *Vice-President*; J. W. YOUNG, *Secretary-Treasurer*.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York 4, N. Y., L. H. GEYER, *Representative*.
Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index.

ON THE COVER

A PICTURE story of the procedure being followed in repairing the frost-riddled upstream face of Barker Dam is presented on pages 113-116. Our cover view shows a neatly tailored 4-ton slab of concrete being lowered into place by a crane on top of the structure. On the inside face of each slab are dowel pins that are welded to anchor bars that may be seen projecting from the existing dam, from which all defective concrete has been removed. The space between the slab wall and the old dam face will be filled with concrete by the Prepakt method.

IN THIS ISSUE

TO INSURE a high rate of heat transfer, the surfaces of modern boilers have to be kept clean. Our leading article describes how this is accomplished with blasts of compressed air. Unusual methods of repairing Barker Dam in Colorado are presented pictorially. An article that should interest prospective homebuilders deals with the construction of walls of the most plentiful material we have—earth. Fremont Kutnewsky tells of the commercial possibilities of yucca and similar desert plants. Among the short articles is one descriptive of a drill sled that was used on a steeply sloping quarry face, and another about a pneumatic system for increasing the pressure exerted by rolls in paper and textile mills.

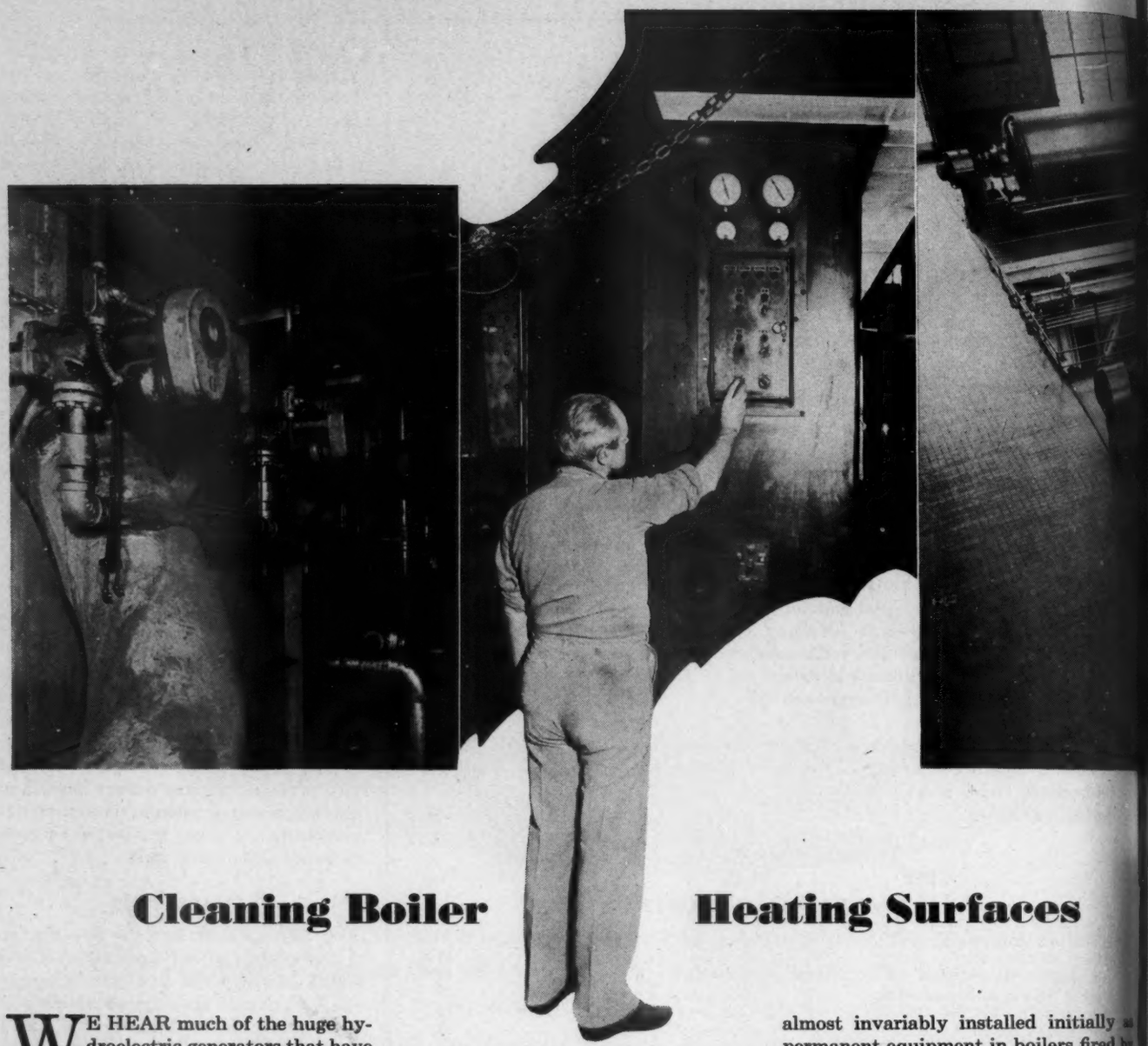
CORRECTION

IN THE article *Radiant Heating*, on pages 90-94 of our April issue, it was stated that wrought-iron pipe is used in the Van Syckle automotive building in Phillipsburg, N. J. Actually, the pipe is a product of Bethlehem Steel Company known as Rayduct, which is made from a special-quality open-hearth steel.

We said that wrought-iron pipe predominates in radiant heating because it has good resistance to corrosion. Bethlehem Steel Company informs us that in a properly designed, closed hot-water system corrosion is of no consequence because the same water remains, or should remain, in the piping, with only negligible quantities of make-up being needed occasionally.

The article also mentions the use of copper or copper-coated steel pipe in sizes smaller than are obtainable in wrought iron. Rayduct is made in sizes down to ½ inch and can consequently be utilized where small-diameter piping is required to fit into certain spaces.

Steel pipe has been used in scores of radiant-heating installations in widely varying types of buildings. Rayduct is now being laid in a 16-story structure in New York City, reputedly the first multistory radiant-heating system in the country.



Cleaning Boiler Heating Surfaces

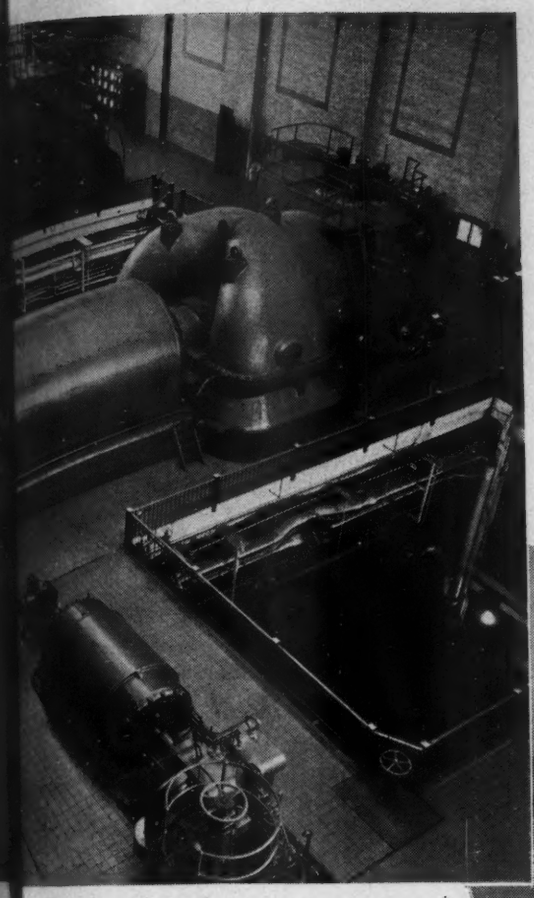
WE HEAR much of the huge hydroelectric generators that have been or are now being built to provide power and light for various sections of our country, but much more will have to be done along this line before steam produced by burning fuel in boilers ceases to be our main power-generating medium. There are innumerable steam plants, small and large, ranging from heating units for buildings to marine boilers for ship propulsion and including many types and sizes of boilers for all purposes up to the giant 8 to 10 stories high capable of evaporating nearly a million pounds of steam an hour and driving a 90,000-kw. electric generator. Continuity and efficiency of operation are mandatory in the case of installations of this kind, and it is our purpose to discuss one of the newer developments.

A steam boiler is an apparatus for abstracting the heat from hot gases and transferring it to water so as to form steam of a desired pressure and temperature. The efficiency of a boiler really consists of two factors: the efficiency of the furnace and that of the heating surface. Our interest lies in the latter. Obviously, the effectiveness of a boiler heating surface in transferring heat from gas to water is greatly altered when it is covered or "insulated" with accumulations of scale and soot. Scale is the deposit normally encountered on the water side; soot, which term also embraces fly ash and slag, is the deposit on the fire side. Soot $^1/_{32}$ inch thick is reported to cause a fuel loss of 9.5 percent; in the case of a $^1/_{16}$-inch layer it is 26 percent; and with thicker deposits it is proportionately more. It is apparent that tubes must be kept free from soot if economy is to be maintained. A corollary is that heating surfaces are liable to "burn out," deteriorate, or fail if not kept clean. Soot removal is therefore essential to continuity and efficiency of operation.

Coal, oil, and gas are the fuels used in generating steam, and soot blowers are almost invariably installed initially as permanent equipment in boilers fired by the first two. Gas, properly burned, causes but little deposit, and what there is may be removed by hand blowers when necessary. The kind of fuel used to produce steam is not always a matter of choice, but depends upon economic and other factors such as availability. Therefore boilers are frequently designed to burn fuel varying considerably in quality, and in many instances provision is made for the alternate consumption of coal and oil. Soot blowers must, consequently, be built for a wide range of dirt conditions.

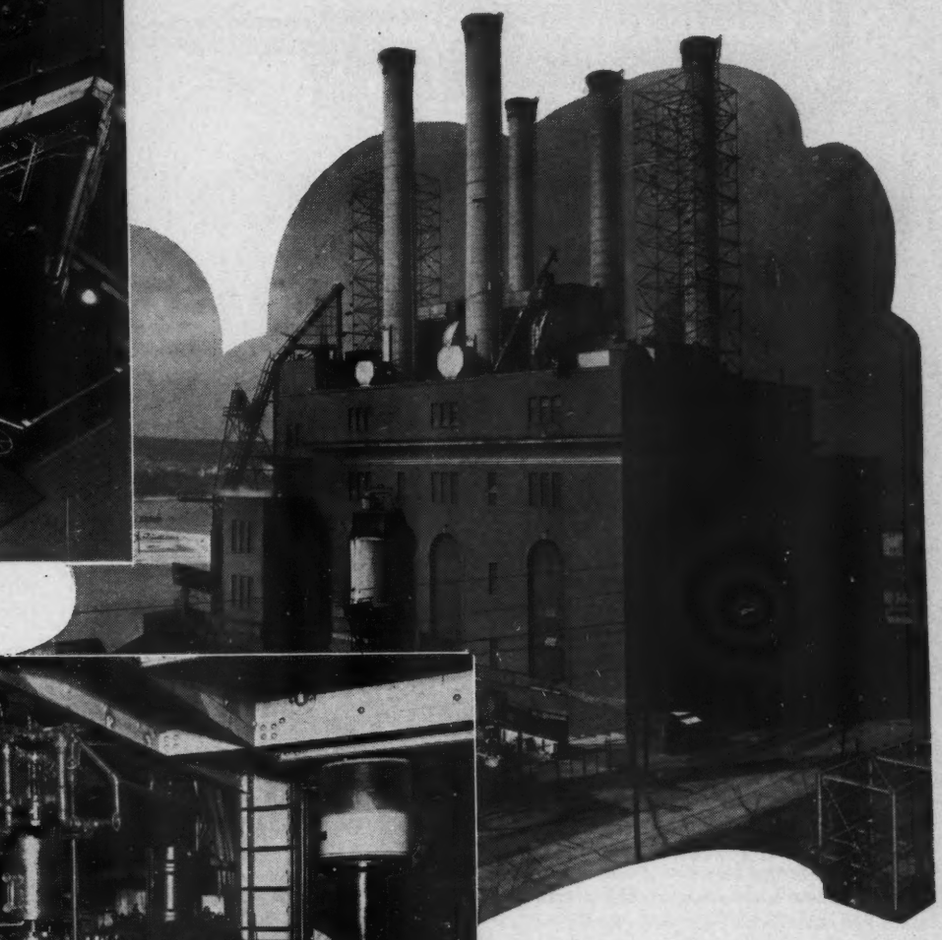
There are three general types of soot blowers, any of which may use either steam or compressed air as the blowing medium:

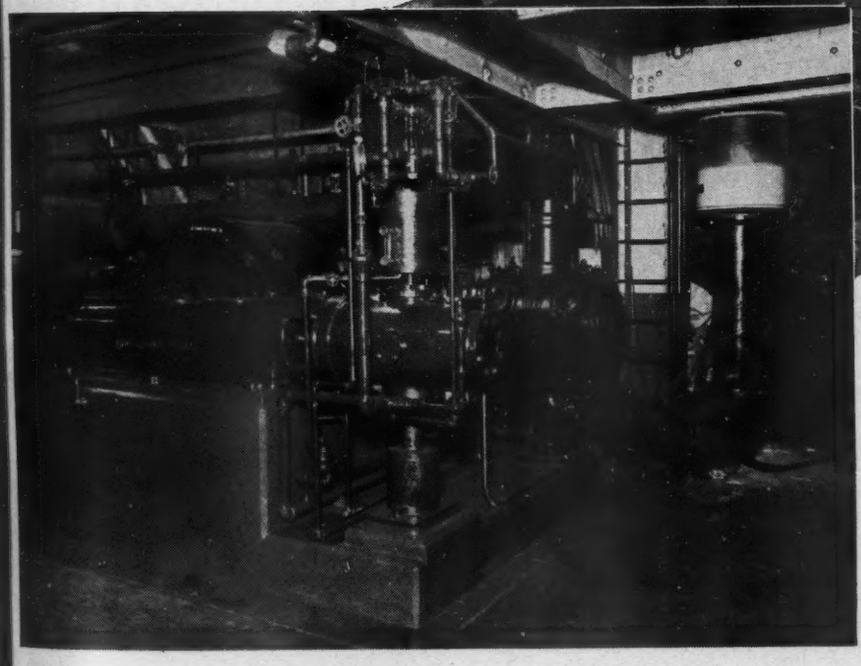
(1) The hand lance, a long pipe with a nozzle at the end, that is introduced manually into a boiler through openings in the casing and manipulated more or less satisfactorily to clean the heat-transfer surfaces with the blast issuing from the nozzle.



SOOT BLOWERS IN LONG ISLAND GENERATING STATION

The Glenwood Station (below) is a unit in the Long Island Lighting Company's system that supplies most of Long Island east of New York City with electricity. Its generator room (left) contains three 75,000-kw. units and one 20,000-kw. machine. The plant boilers burn coal of varying grades and are equipped with soot blowers using compressed air. The heads of several Diamond continuous blowing units at one boiler level are shown at the extreme left. The blowing elements project into the boiler from the heads and are retractable. Operation of the blowers is controlled from a panel (picture with man) located in the boiler room. Compressed air for blowing is furnished by two Ingersoll-Rand duplex compressors that discharge at 500 psi. and is stored at 500 and 250 psi. Some of the output is reduced to 100 psi. for pneumatic tools used in maintenance work. One of the two compressors is pictured at the bottom.

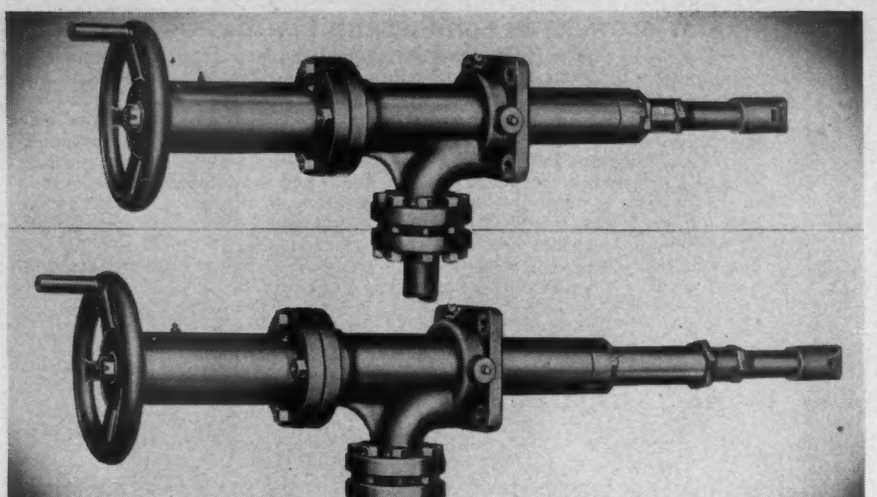




(2) Permanently installed "elements," each consisting of a pipe with nozzles. These are rotated individually by hand so as to cover the greatest possible area and are located in such a way as to clean a certain section of a boiler most advantageously.

(3) The retractable kind that is designed to clean surfaces in zones where temperatures are too high to permit a permanent installation. These blowers are mounted in shielded recesses in the boiler casing and projected into the furnace only when in service.

There have come into use in recent years modified types of the two last-mentioned blowers. These are designed to function automatically and thus to relieve labor of tedious work while permitting closer control of conditions within a boiler. Automatic operation in these cases involves more than opening and closing the power valves to the individual blowers—the systems are automatic throughout. Panels are now set up in the control rooms of large power plants whereby a predetermined cycle of blowing is started, stopped, modified, and controlled. A boiler may be blown sequentially; that is, in a definite, progressive manner from front to back, bottom to top, etc., as may be desired, or some sections (elements) may be bypassed and not blown at all. These systems are available for all types and sizes of boilers and ordinarily use compressed



FOR HOT SPOTS

Single-nozzle blowers that can be extended and then retracted into protected wall boxes are used in extremely hot locations where replacement costs on multiple-nozzle elements would be high or where unusually large volumes of air are needed for effective cleaning. A Diamond unit of this type is shown here both retracted and extended.

air for control, regardless of the blowing medium.

Steam soot blowing has been general because of the immediate availability of steam—the boiler to be cleaned supplying it. However, compressed air is of advantage in many instances and has been coming very much to the fore. Air power is no newcomer in this service. Central-station installations date from about 1926, and others have followed with excellent results. In 1932 a comparison was made between manually operated steam blowers and automatic air blowers on duplicate boilers in the same plant and proved most favorable to air. Air power has also been used extensively with heating boilers where steam pressures are not sufficiently high for effective cleaning.

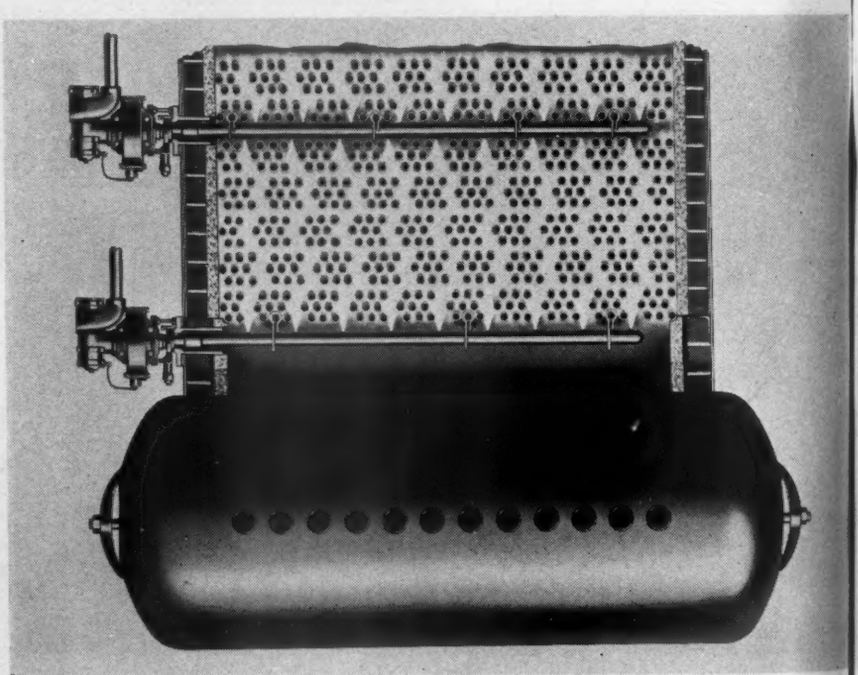
The growing demand for automatic systems, and the situation that led to it, was described as follows by a leading manufacturer of equipment of this type: "The rapid increase in boiler steaming rates, the increase in investment for a single boiler, and the corresponding importance of maintaining clean heat-transfer surfaces, emphasized the necessity for a cleaning system which assured positive operation of every blower unit in correct sequence, with sufficient nozzle pressure and at the right speed every time. The scarcity and the inexperience of labor available in power plants in recent years have again stressed the necessity for automatic operation. The present high cost of labor makes it possible to offset the difference in cost between the manual and the automatic systems in a reasonable period of time."

The advantages of air power over steam are listed as follows:

(1) Drier blowing medium lessens corrosion of heating surfaces, particularly when they are operating near the dew point.
(2) No boiler-feed-water make-up is required (steam is lost with steam blowers).
(3) There is a saving in energy from the coal pile.
(4) Piping installation is less expensive because there is no need of insulation, provision for drainage, etc.
(5) Reduced blower maintenance, as indicated by existing installations.
(6) More effective slag removal because of the greater density and chilling effect of the lower-temperature compressed air.
(7) Because air cleaning is intermittent, it is usually spread over a longer period of time than steam blowing. Therefore boiler operating conditions are not upset during the blowing cycle.
(8) Intermittent blowing also controls fly-ash flow in the gas to the dust collectors or atmosphere.
(9) Greater deck cleanliness in marine installations.

Space restriction does not permit elaboration of the foregoing points, but numerous reports by managers of plants where pneumatic soot blowers have been in operation for considerable periods attest to the substantial economies and other benefits realized by their use.

When gathering material for this article, the writer visited the Kearny Generating Station of the Public Service Electric & Gas Company of New Jersey where there is a mercury-boiler installation capable of producing about 20,000



MARINE AIR-PUFF SOOT BLOWERS

During the war period, some 800 marine boilers were equipped with Air-Puff soot blowers, and as they were introduced in 1932 they have been installed on approximately 1800 boilers on land and sea. The compressed air is discharged from the element nozzles in short puffs, with substantial pauses in between. During the pauses the element is automatically rotated to a new position. Intermittent operation enables the compressors to store air in the receivers during non-blowing periods and consequently permits the use of smaller compressors than would be possible if blowing were continuous. This makes for economy, and is especially important aboard ship where space is at a premium.

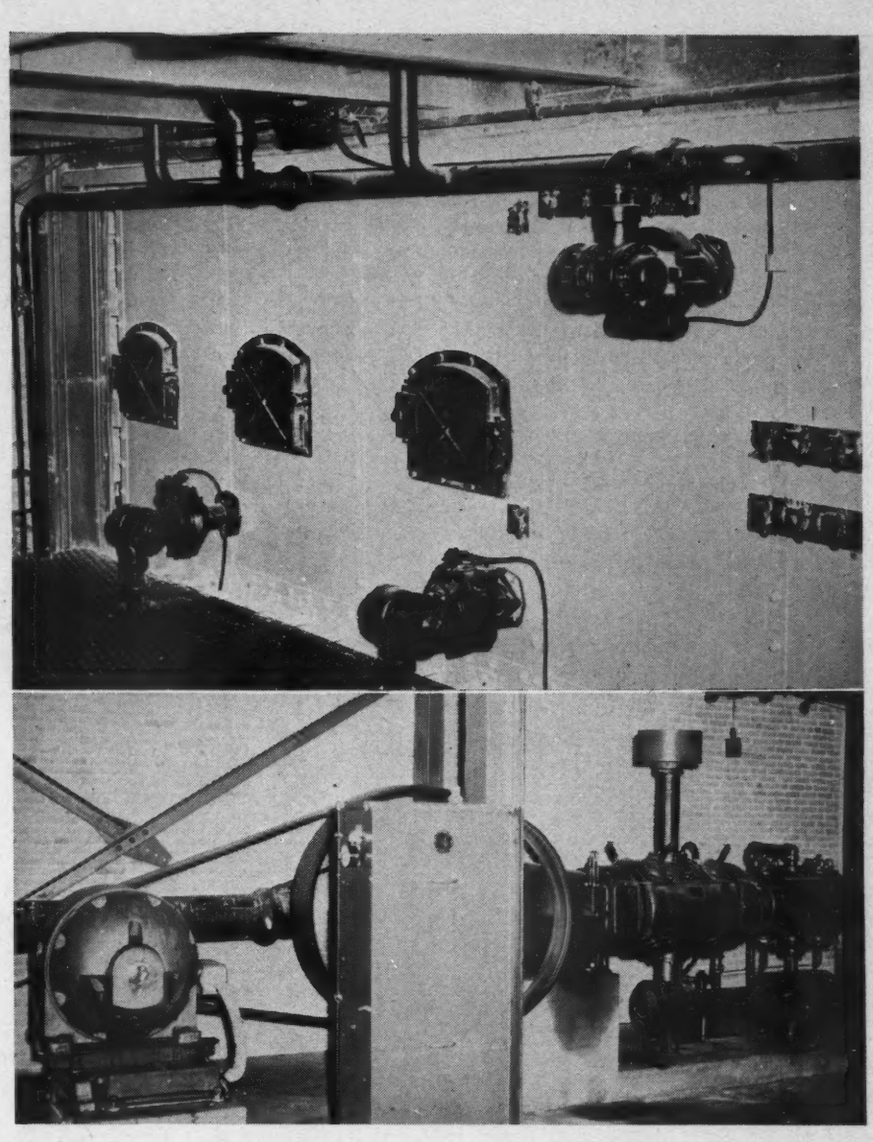
kw. on the mercury side and 25,000 kw. on the steam side. That boiler is provided with pneumatic soot blowers, which were obtained in 1945 to supplant steam soot blowers that had been put in service four years earlier. A 3-stage compressor, discharging 1000 cfm. at a pressure of 500 psi. was also purchased. The blowers are of the Diamond Power Specialty Corporation telescopic type of manual-control pattern and are to be refitted for automatic control. Depending upon the location of the boiler tubes, the blowers clean with air at 250 or 500 pounds pressure.

The boiler holds 440,000 pounds of mercury, and any loss of that heavy liquid through leaky boiler tubes might quickly become a costly matter. The plant management found that steam blowing, with moisture combining with the sulphur in the combustion gases, produced an acid that attacked the boiler tubes and caused what is termed "punch cracks"—superficial transverse scratchlike etchings that tend to deepen and threaten fractures. That has been the primary reason for adopting air soot blowers. Steam blowing has the same drawback in virtually all boilers, and that accounts for the increasing recourse to compressed air as the cleaning medium.

Another interesting installation is that at the Glenwood Station of the Long Island Lighting Company at Glenwood Landing, N. Y. As explained by W. Welch, Jr., steam power engineer of the Long Island Lighting Company: "The Long Island Lighting Company system serves nearly all of Long Island east of New York City and that part of Rockaway within the city limits. This territory comprises residential, farming, resort, and industrial sections. In the westerly part adjacent to New York there is a comparatively well-built-up zone of suburban communities. In recent years a large avaition industry has been established in the vicinity of Farmingdale.

"Before 1941, demands consisted mainly of residential plus commercial, transportation, and other service loads typical of an area of this kind. Being predominantly for lighting purposes, the load was characterized by high peaks and low generation and, therefore, low-load factors . . . . Load increase in the last twenty years has been sevenfold because of territorial development, improved living standards, and company sales-promotion activity. Since 1942 the industrial load has grown at an accelerated pace largely on account of aviation and associated war industries—in fact, has practically doubled and was about 35 percent of the total at the war's end. Generation increased more rapidly than peak demand, resulting in higher load factors."

The foregoing description of this large plant indicates how it has had to expand in the course of two decades to keep pace with requirements, and even at this time there is in process of installation a new boiler that is designed to have a steam-generating capacity of 400,000 pounds per hour. The power station contains two turbogenerators of 75,000 kw. capacity and a third unit of the same type having a capacity of 20,000 kw. In addition, there is a 3000-kw. house generator. The three main units are General Electric machines that operate with steam at a pressure of 400 pounds and at a temperature of 750°F. The steam plant in service early in 1946 consisted of five water-tube boilers that had been installed at different times in



BLOWERS FOR BLACK-LIQUOR BOILER

In the soda process of digesting pulpwood, alkali at high temperature dissolves all the wood but the cellulose, leaving the latter in a suitable form for making paper. The cellulose is washed out and the remaining dark-colored liquid is known as black liquor. It is about 90 percent water, and the remainder is organic matter and sodium carbonate. It is desirable to recover the alkali, and this is done by evaporating the liquor and then burning out the organic matter. In some mills this heat is not wasted but is used to raise steam. These pictures were taken in a high-pressure, black-liquor-fired boiler plant which was the first of its kind to adopt automatic soot blowers. The boiler generates hourly 95,000 pounds of steam at 560 pounds pressure and 725°F. temperature. As fed to the furnace nozzles, the liquor contains 81 percent solids. Because of its low heat value, it does not ignite immediately but falls 20 feet to a burning fuel bed that covers the entire floor of the furnace. Fuel of this type, as can be readily realized, produces deposits that tend to foul boiler tubes. To prevent entrained solids in the flue gas from bridging over, the boiler and superheater tubes are widely spaced. There are 26 Diamond automatic-type Air-Puff blowing elements that use 250-pound air. They are operated once a day, except where flue gas rises perpendicular to the tubes where blowing is done three times daily. The top half of the furnace has 400 small ports to make the tubes accessible for hand lancing, which is done with 100-pound air in those areas not equipped with mechanical blowers. The pictures show some of the Air-Puff soot-blower heads and the Ingersoll-Rand straight-line compressor that supplies air for blowing.

order to meet growing service demands.

Glenwood Station is using low-volatile bituminous coal obtained from the eastern section of the country and having 18.4 percent of volatile matter, 6.6 percent of ash, and a heating value of 14,367 Btu's per pound. The boilers have to operate from season to season with coals of variable grades, and as the plant is located at a narrow section of Hempstead Harbor where delivery by water may be interrupted by ice in the wintertime, a certain number of them are equipped to burn fuel oil, also of whatever grade may be available.

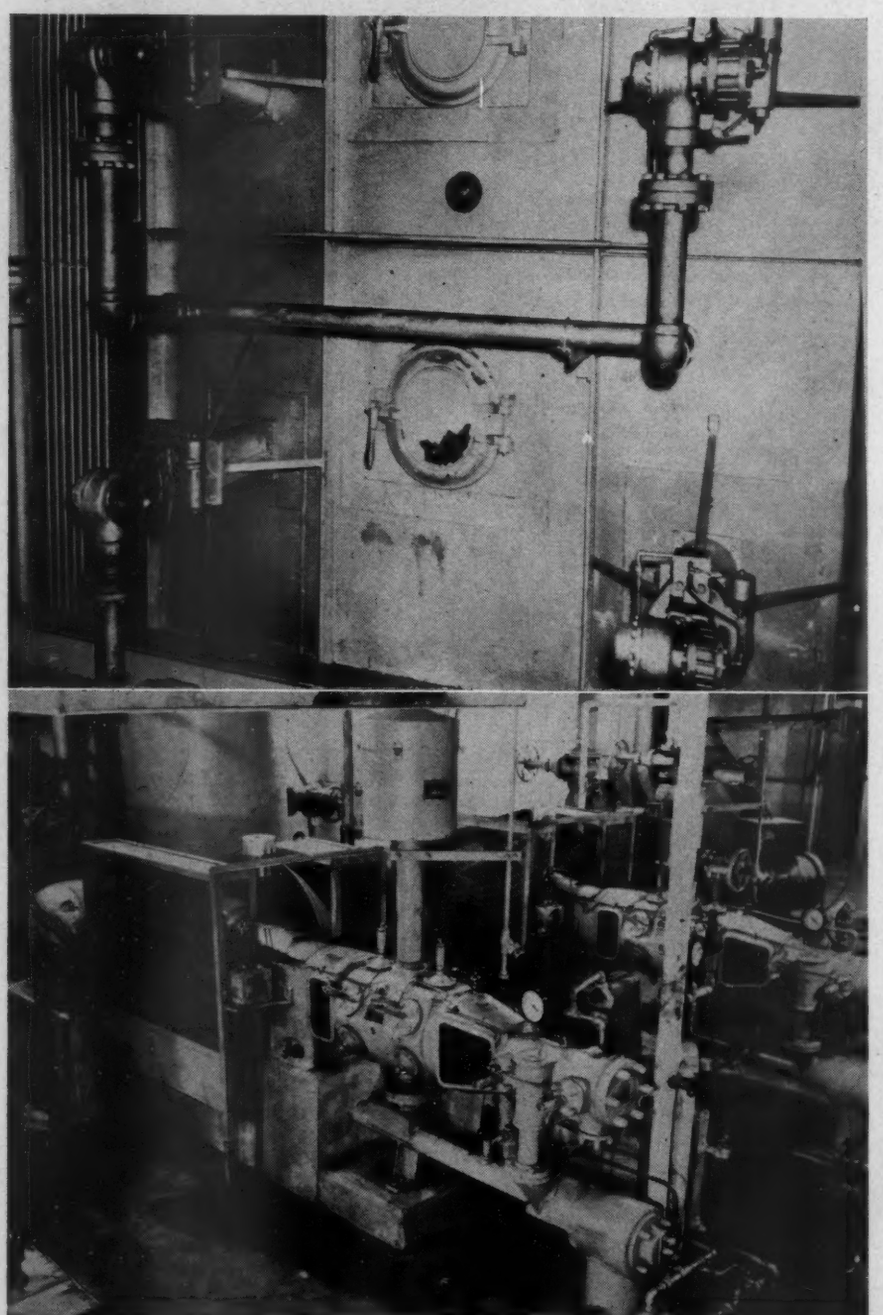
The coal is pulverized and delivered to the burners by air-operated Fuller-Kinyon pumps, igniting instantly to fill the furnace with incandescent gases that rise to a height of 30 or 40 feet above the level of the burner nozzles. The hot gases, with their incombustible soot and fly ash, continue upward for approximately the same distance to heat the banks of boiler tubes, the superheaters, the economizers, and, finally, the air heaters which use as much as possible of the heat remaining in the gases before they escape into the smokestacks. All these heat-transfer surfaces, wherever they invite deposits of soot, are swept clear of those insulating coats regularly and at short intervals by Diamond Air-Puff automatic soot blowers that increase the total percentage of utilized Btu's generated by each pound of fuel burned.

The accumulation of soot on a boiler's heating surfaces is rapid and more troublesome when certain types of low-grade fuel oil are burned; and Air-Puff blowers are notably effective in dislodging the deposit. Just before the flue gases enter the smokestacks, the suspended solids are caught by electric precipitators mounted on the roof of the plant. On one of the gallery levels of the boiler room is a control board or station from which any or all the soot blowers can be brought into action for any group of boilers; and once the function is started, it continues automatically to the completion of the sweep or arc for which the unit or units are set.

Compressed air for the blowers is provided by two heavy-duty Ingersoll-Rand XRE 2-stage compressors that deliver it to receivers built to hold air at 500 and 250 pounds, respectively, and to an additional tank in which pressure is maintained at 100 pounds per square inch. The latter furnishes air to drive pneumatic tools of different kinds, to do spray painting, and to take care of other services in and about the plant. The fact that the automatic soot blowers and compressors have been in service for some years, and that air soot blowers will be part of the equipment of the new boiler, is sufficient evidence that they have amply proved their value.

The Air-Puff System pioneered by Diamond Power Specialty Corporation is a development that makes the utmost use of air power, accomplishing maximum cleaning with a minimum investment. It is essentially a rotating-element system with fully automatic control arranged to give air blasts of about one-second duration, with intervals between blasts of from a few seconds to a minute, depending upon various factors. During the puffing period the element is turned slightly, and successive blasts cover different sections of the boiler. It is claimed that repeated puffs are more effective in dislodging soot than a continuous blast. This type of blower also provides more uniform cleaning, reduces labor costs, and minimizes atmospheric pollution. It was effectively used on more than 800 marine boilers constructed during the war for our shipping.

Compressed-air soot blowers are also being used in connection with so-called "recovery" boilers in paper mills where the "soot" developed by burning black liquor as fuel is especially corrosive and sticky when steam is employed. Air power has again proved its adaptability.



IN A MIDWESTERN POWER STATION

Air-Puff soot blowers are used to maintain clean surfaces on the superheater and economizer tubes of a boiler rated at 500,000 pounds of steam per hour at 1250 pounds pressure and 925°F. total temperature and are also employed in the air-preheater section. The heads of four of the twenty elements are shown in the upper picture. Below are illustrated two Ingersoll-Rand 50-hp. compressors that furnish the air for operating the blowers.

Unique Methods Used to Restore Old Power Dam

1 A view of Barker Dam, with a full reservoir behind it, taken several years ago. Built in 1909-10, the structure is 175 feet high, 120 feet thick at the base, 16 feet thick at the top, and 720 feet long at the crest. The water stored during the spring flood season is conveyed by conduit to operate a 20,000-kw. generating station several miles downstream. The settlement in the background is the mining camp of Nederland, which boomed during World War I because of the production of tungsten in the surrounding hills. On the horizon are the snow-capped peaks of the Continental Divide.

2 Looking across the crest of the dam during the preliminary stages of the restoration work. The reservoir at the left has been drawn down low by summer operation of the power plant. On the opposite abutment are the contractor's buildings.

SITUATED in the Rocky Mountains at an altitude of 8200 feet and 17 miles west of Boulder, Colo., 37-year-old Barker Dam was somewhat deficient in mass for a gravity-type concrete structure and its upstream face had become badly deteriorated through frost action.

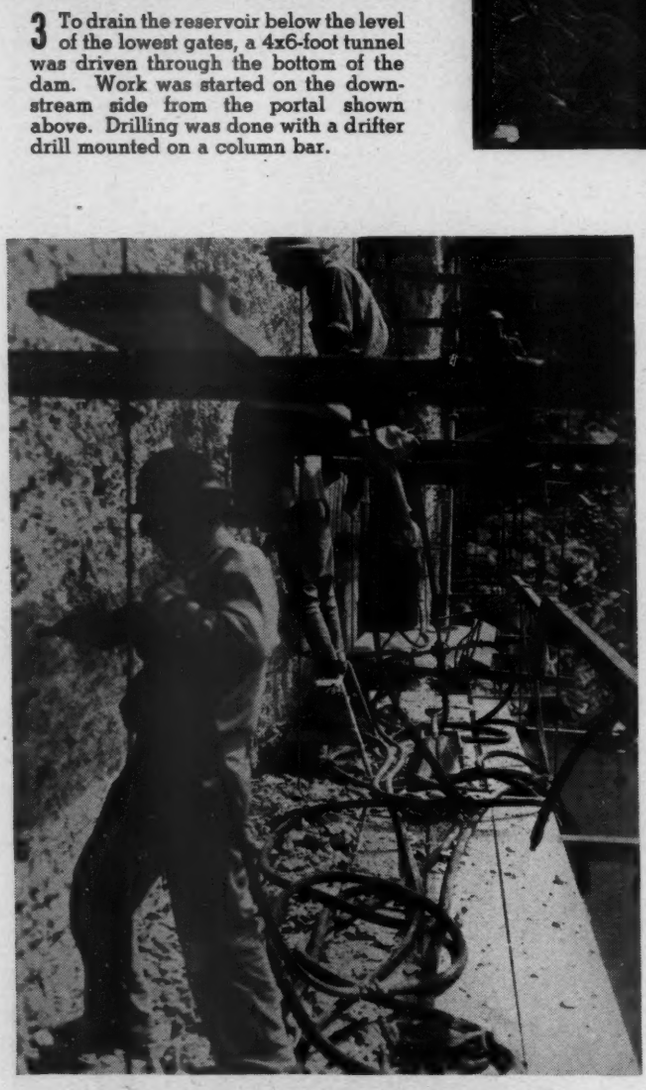
To stabilize and restore the dam, the Public Service Company of Colorado is employing some unique construction methods. Principal among these is the use over the entire face of forms of reinforced-concrete slabs. These are of air-entrained concrete and are secured to the existing structure by lap-welding protruding dowels, that were cast in the slabs, to anchor bars grouted into the dam.

The space between the slabs and the old face is filled with coarse aggregate that will be made into concrete by the Prepakt process after all the slabs and aggregate are in place and after the reservoir has been filled. One advantage of this method of restoration over conventional practices is that it enables the work to be conducted through the severe winter months without the necessity of wasting a season's runoff of water.

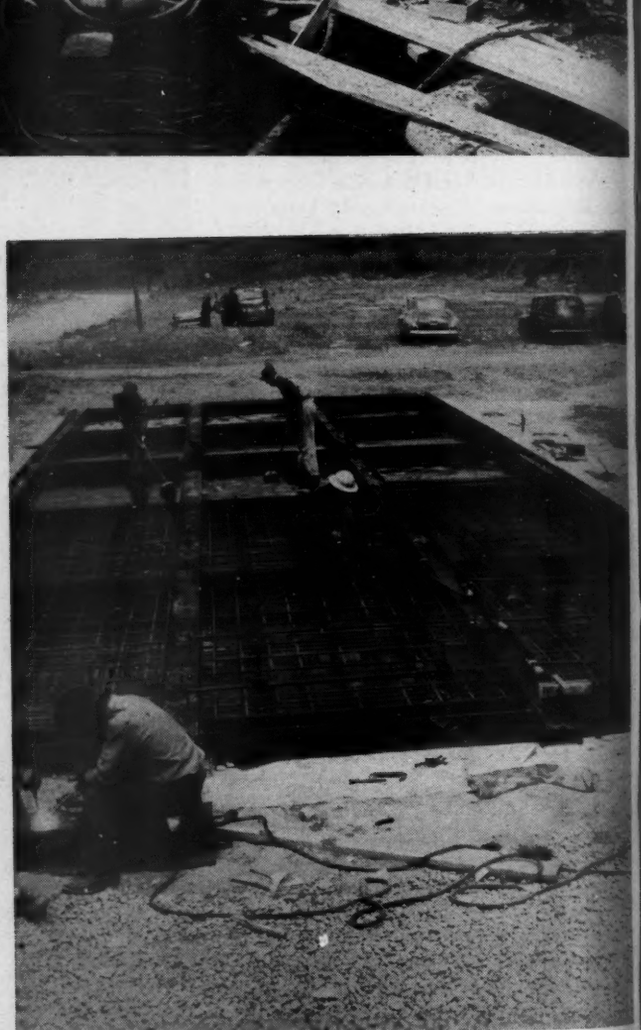
The Prepakt Concrete Company, of Cleveland, Ohio, is the general contractor, and John Hofer is its general superintendent. The work is being engineered by Dr. Raymond E. Davis, consulting engineer, of Berkeley, Calif., with William T. Neelands serving as his resident engineer. Representing the Public Service Company of Colorado, and closely associated with the job, are E. Clinton Jansen, chief hydraulic engineer, and L. B. Card, mechanical engineer.

3 To drain the reservoir below the level of the lowest gates, a 4x6-foot tunnel was driven through the bottom of the dam. Work was started on the downstream side from the portal shown above. Drilling was done with a drifter drill mounted on a column bar.

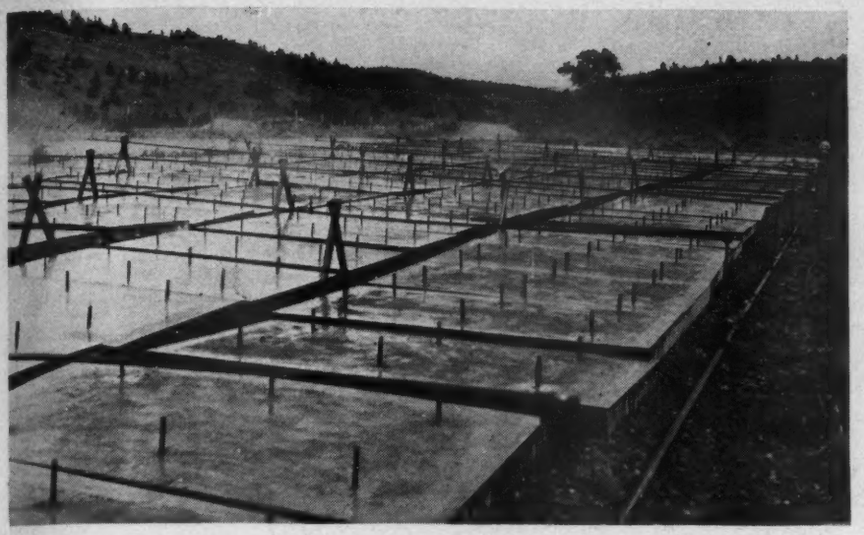
4 The first step on the upstream face of the dam was to chip away the defective concrete, the operation being started by men working on rafts. The picture below shows something of the condition of the concrete surface after 37 years of intermittent frost action.



5 Later on the crews worked from scaffolding. Enough of the upstream face of the dam had to be removed to expose sound concrete everywhere. Twenty Ingersoll-Rand 400-C air-operated chipping hammers were used for this purpose.



6 Meanwhile, reinforced-concrete slabs for the new face of the dam were being precast at an upstream site. This view shows prefabricated reinforcing mats in some of the forms. Wide-flange steel beams served as sides for the forms and rested on a concrete base containing hydraulic pressure plates for breaking the bond between the precast slabs and the forms.



7 Upon removal from the forms the slabs were cured under water sprays for 90 days. Six accurately positioned steel dowel pins were partially embedded in each slab. When the slabs were later assembled, the pins were lap-welded to anchor bars extending from the chipped face of the dam.

8 The upstream face of the dam (below) during the final cleaning stages. Anchor bars are shown grouted into holes put in with rock drills. Some of the men are sand-blasting the chipped concrete surface. Uncovered at the bottom are timber supports for stiffleg derricks used in the original construction work. The wood proved to be sound despite its long submergence.

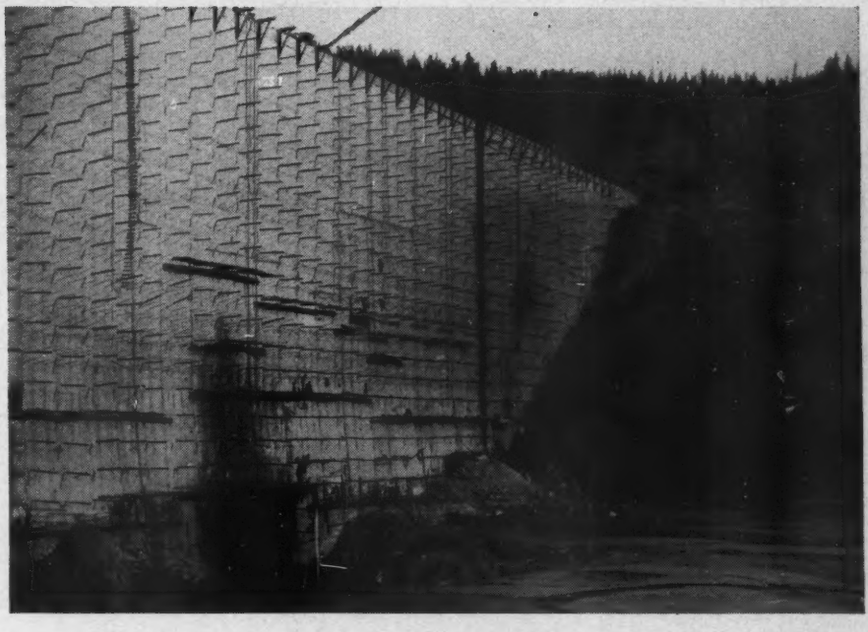
HISTORICAL BACKGROUND

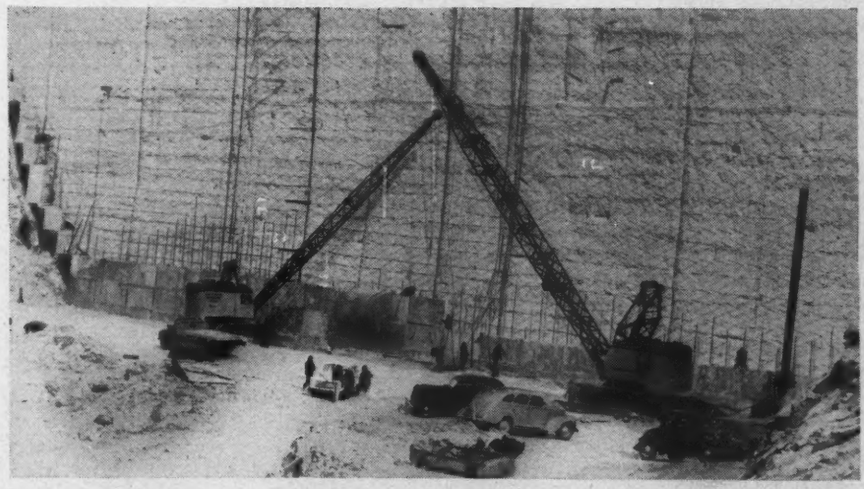
BARKER DAM is named for J. W. Barker, an executive of the Public Service Company of Colorado during the first decade of the century. It was the second concrete dam reared by that utility, the first one—the Shoshone Dam—having been constructed in 1906 near Glenwood Springs on the upper reaches of the Colorado River.

The company is of interest in connection with the nation's public-utility history because it was organized by Henry L. Doherty, who went from Denver to New York to found Henry L. Doherty & Company and the Cities Service Company, both nationwide in scope. When Doherty arrived in Denver in 1898 he was only 28 years old but already had had sixteen years of experience in the gas and electric business, having started as an office boy with the Columbus (Ohio) Gas Company and subsequently been identified with companies in Madison, Wis., St. Paul, Minn., and San Antonio, Tex.

Denver was at that time served by the Denver Gas & Electric Company, which was the outgrowth of several older concerns dating back to the Denver Gas Company, which was founded in 1869. One of the intermediate concerns, The Colorado Electric Company, organized in 1881, attracted attention by the method of street lighting it used. Eight high towers, each with 3000 candlepower of arc lights, were erected at strategic points to illuminate the business district. This system served until 1890, when the Denver Electric Illuminating Company was formed. One of the signers of the $25,000 bond it posted to guarantee fulfillment of its franchise provisions was H. A. W. Tabor, who had become a national figure after grubstaking himself into a mining fortune at Leadville.

It was in Denver that Doherty first displayed his genius for organization by knitting together an electric-service network that covered much of the state. The Colorado properties formed a part of the nucleus of the far-flung utilities chain that was afterward forged by him.





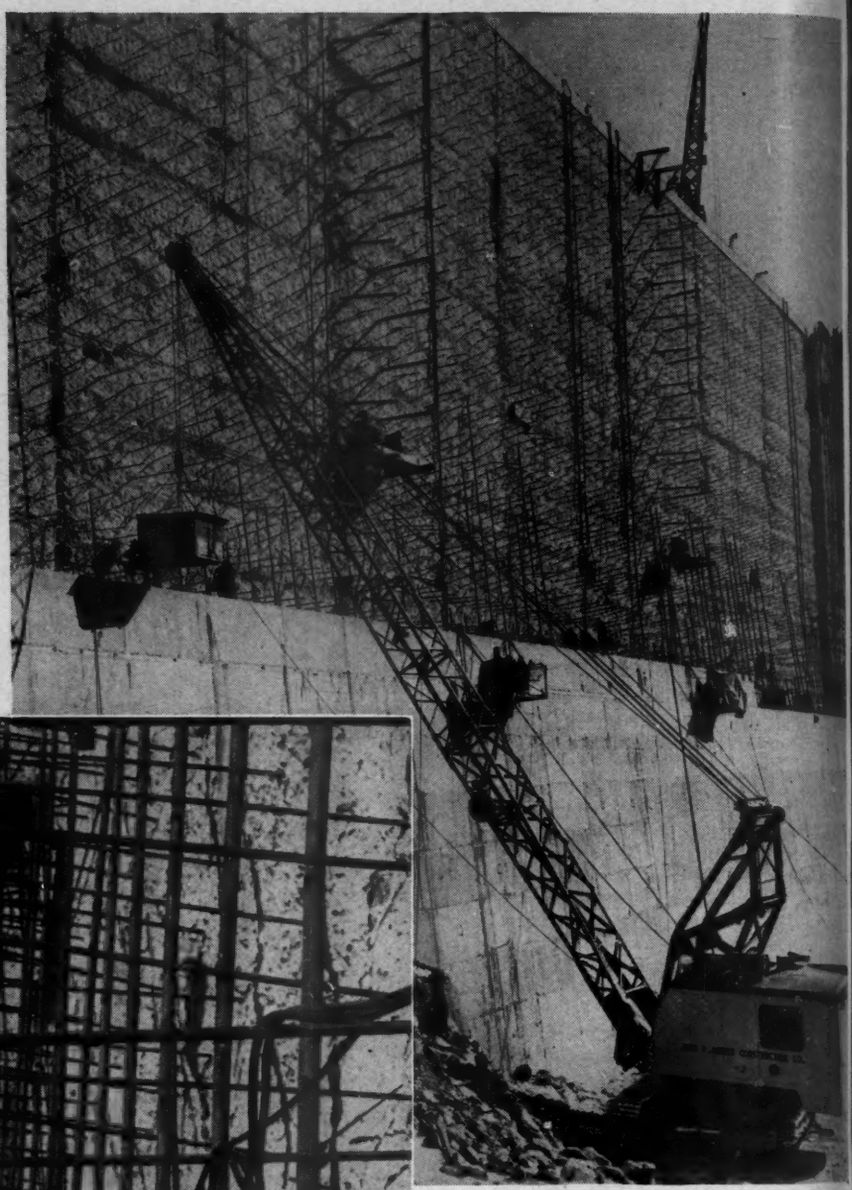
9 Beginning the job of placing the new face of precast-concrete slabs. One crane handled the slabs, while the second one put aggregate in the space between them and the existing dam face. When the wall had exceeded crane height, both operations were performed by one crane stationed on top of the dam and working alternate shifts.

PHOTO CREDITS

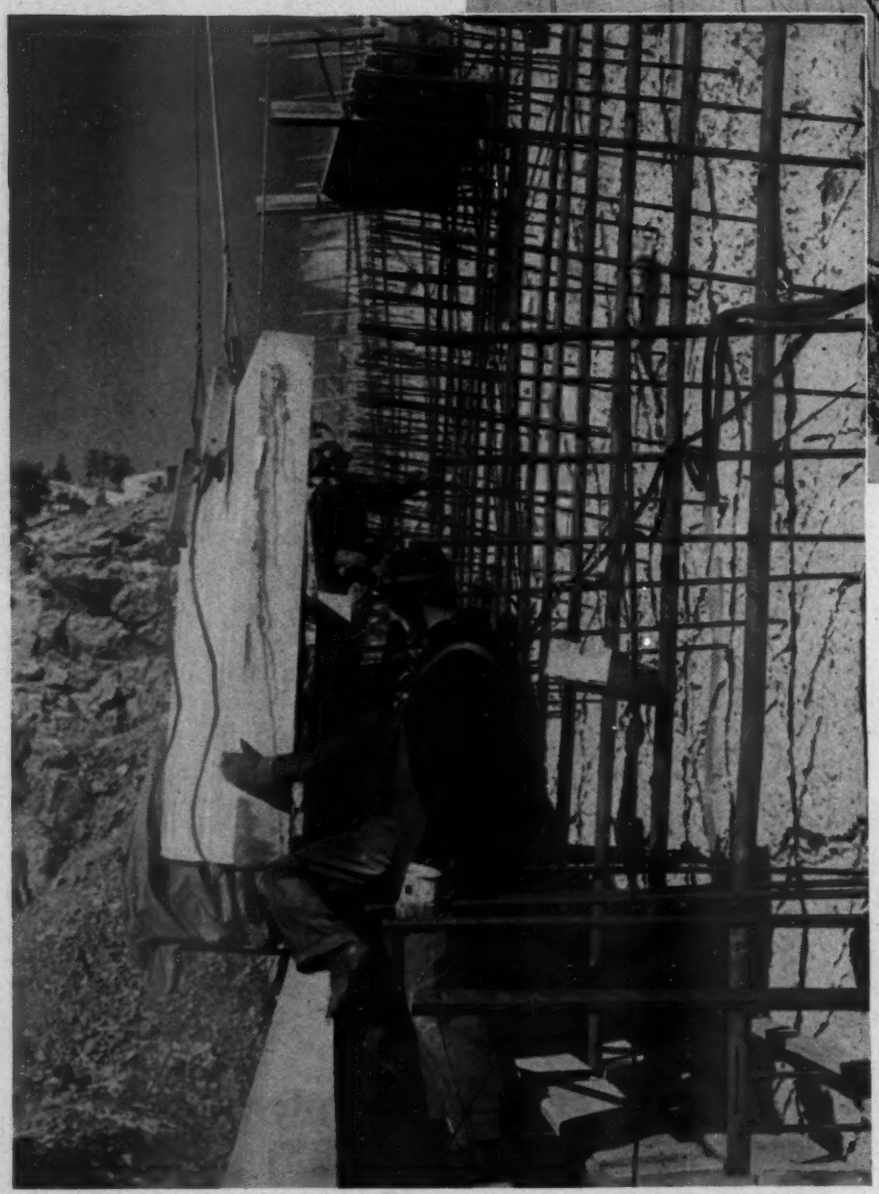
Public Service Company of Colorado—Nos. 1 and 4

R.G. Zellers—Nos. 2, 3, 5, 7, 10 and 11

Dr. Raymond E. Davis—Nos. 6, 8 and 9



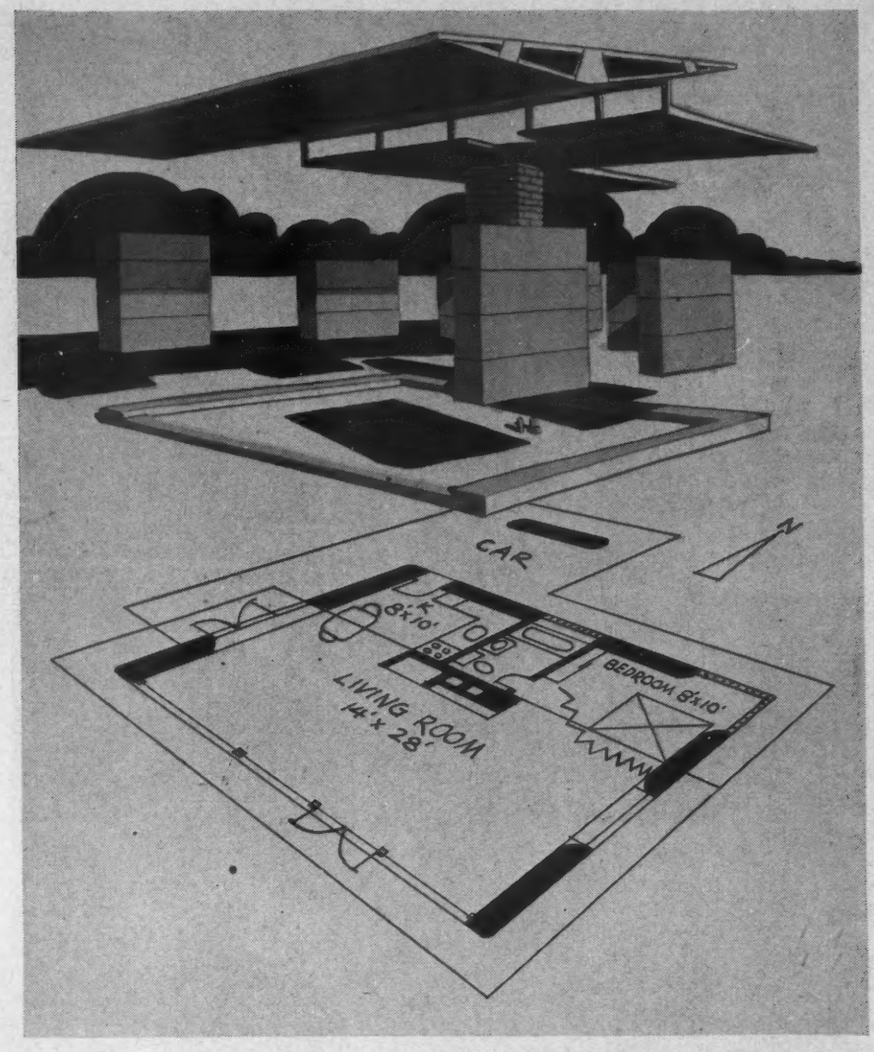
10 The wall progresses (right). The crane in foreground is handling a box of aggregate. The second crane has been transferred to the dam crest and still has a grip on the slab being placed at the right end of the top course.



11 Close-up of the slab setters (left) amid a maze of anchor bars, guiding one of the tailored concrete blocks into position. The space where they stand will be filled with Prepakt concrete. The man in the foreground, wearing earphones, directs the crane operator atop the dam.

Houses Built of Earth

Mat Kauten



BASIC ELEMENTS OF RAMMED-EARTH HOUSE

At the bottom is the floor plan, and above it the rammed-earth piers are shown in their respective positions. The specifications provide for no foundation, the footings of the walls are to rest on broken stone. The floor would be of soil cement and the roof an inverted truss formed of 2x4's.

HERE is a design for a home that can be built now when economic conditions have combined to block all manner of construction. The plan meets the present critical housing situation by getting down to *earth*, the most ancient of building materials. With modern compressed-air tools and streamlined production methods, rammed earth offers a relatively low-cost dwelling.

The technique of tamping earth in forms provides a wall of superior quality without the use of other ingredients. Its characteristics explain its desirability, for such a monolithic structure is proof against fire, dampness, and termites. It requires no insulation whatever because its thermal conductivity is practically zero, and it has a compressive strength of from 18 to 33 tons per cubic foot—strength that increases with age. This is attested to by time, many buildings of this type both here and abroad being hundreds of years old.

Rammed-earth walls need no plastering or painting, though both are possible; and maintenance cost is low enough to be negligible. As for construction, it is a "once-over, all-over" method by which all the separate steps of framing, outside and inside surfacing, and in-between insulation are eliminated. Actually, when the many steps and processing of materials that go on before and after the "show" at a building site are considered, it takes longer to put up a prefabricated, demountable house than to construct one of earth by mechanical means.

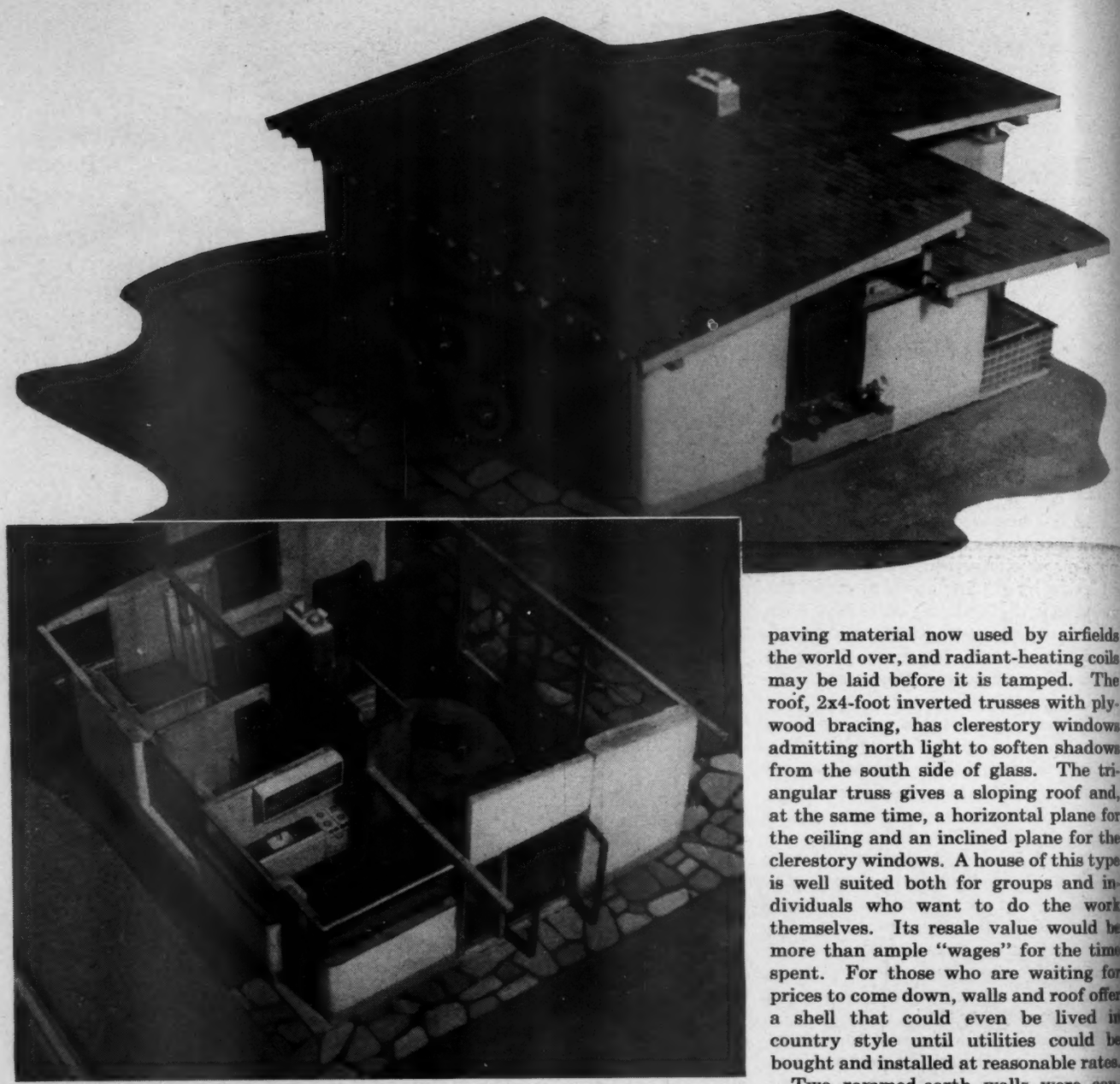
Outstanding examples of modern homes of tamped earth are to be found on two government projects that were built within the last ten years by the architect Thomas Hibben. In 1936 he designed seven rammed-earth houses for the Farm Security Administration that were built at Gardendale, Ala., by WPA labor and with materials that represented the smallest percentage of the costs. In 1942 he completed several multiple dwellings near Alexandria, Va., (Federal Works Agency) by the use of air-driven tampers. This was the first attempt towards the mass production of rammed-earth walls and the outcome of progressive experimentation.

The problems in the past have always been the bottlenecks of slow and tedious hand tamping and heavy forms that were back-breaking to lift and readjust after each course. The present-day solutions are compressed-air tamping, easily handled forms, and plans which take the building medium into consideration: unit wall lengths that permit the use of standard forms, arrangement of walls to do away with corners, and windows and doors that extend to the ceiling to eliminate tamping earth over lintels.

TWENTY years ago we published an article on rammed-earth construction which aroused so much interest that we still get requests for copies of it. Now, because of high costs and scarcity of conventional building materials, increasing attention is being paid to this age-old type of construction, which is known abroad as *pisé de terre*.

The author of this article reports on experiments he has conducted with a view to determining the most effective and economical methods and equipment for building rammed-earth structures. He concludes that tamping with air-driven tools offers definite advantages.

Among the illustrations are a plan drawing and several views of a model of a small house that was designed by the author. A bibliography at the end of the article gives sources of more detailed information on the actual building of rammed-earth structures.



MODEL OF THE HOUSE

At the top the structure is viewed from the southeast; at the bottom it is pictured from the northeast and with the roof removed to show the interior.

The home illustrated was designed for tamped-earth construction in accordance with the foregoing specifications. It literally grows from the ground. Six 8-foot piers 1½ feet wide, with windows, doorways, and a terrace between, hold up the roof. The floor plan is such as to obviate the necessity of special corner forms and is square, giving the most floor space with the least wall length. It is a monoroom wrapped U-shaped around a bathroom, with the plumbing all in one wall. This basic structure is sufficient for two people. A second bedroom, laundry, utility and workshop can be added later, should they be desired.

The south wall of the house is of glass, with the right amount of eave projection that will allow the low, slanting rays of the winter sun to enter with their solar heat. The same eave also will keep out the overhead sun in summer, the room then being in complete shade. On the north side, full advantage is taken of the insulating value of earth walls, and instead of the usual windows set in openings right in the walls, a band of small windows extends across the entire wall right underneath the eave. Tamping ceases at the sills of these windowettes.

There is no foundation in the usual sense. Broken stone provides drainage and supports the piers and floor much like the ballast of a railroad bed supports track and train. (The FWA project placed a simple concrete slab on the ground.) The floor is of soil-cement, the paving material now used by airfields the world over, and radiant-heating coils may be laid before it is tamped. The roof, 2x4-foot inverted trusses with plywood bracing, has clerestory windows admitting north light to soften shadows from the south side of glass. The triangular truss gives a sloping roof and, at the same time, a horizontal plane for the ceiling and an inclined plane for the clerestory windows. A house of this type is well suited both for groups and individuals who want to do the work themselves. Its resale value would be more than ample "wages" for the time spent. For those who are waiting for prices to come down, walls and roof offer a shell that could even be lived in country style until utilities could be bought and installed at reasonable rates.

Two rammed-earth walls were constructed near Danbury, Conn., in May, 1944, for the purpose of making comparative tests of hand and compressed-air tamping, as well as of stabilized veneers. The piers are 1½ feet thick, 4½ feet long, and 5 feet high, and accompanying photographs show them after two years of weathering. Samples of earth were taken from eight different locations on the property to determine which was best suited for ramming. These were oven-dried, weighed out in quantities of a pound each, and washed to remove all clay and silt very much like panning for gold. The remaining sand was again dried and reweighed to ascertain the sand-content percentage, which is one index of quality. Testing for colloidal content by the "hydrometer" method, as is done by the South Dakota State College Experiment Station, is more reliable. The best specimen contained 61 percent of sand. Compared with the Experiment Station's soil chart

(which showed earth with 75 percent of sand to be the most satisfactory), it was concluded that the former was only medium fair for tamping and would require stabilization for best results. Because of the short time the air tamper and the portable compressor were available, it was decided to proceed regardless of the soil-test findings.

One wall is entirely of earth that came from the site, while the soil in the other was given a sand content of 75 percent by adding sand. Each wall was rammed by hand until it was 2½ feet high, and from there on the work was done with the air-driven tool. One end of the wall that was built of the sand-enriched earth is veneered or coated with a 5 percent soil-cement mixture. This was applied by throwing the material into and along the outer side of the form while tamping. Mixing sand or cement with the earth took so much time that it would obviously be a decided advantage to have naturally good tamping soil in the first place. As the pictures show, the coated section weathered better than the other, as was to be expected, but it was also determined that earth generally not considered favorable for tamping is suitable. Scientific data on recent soil-cement road and airport-runway construction—a method that is no longer in the experimental stage—are available in technical journals.

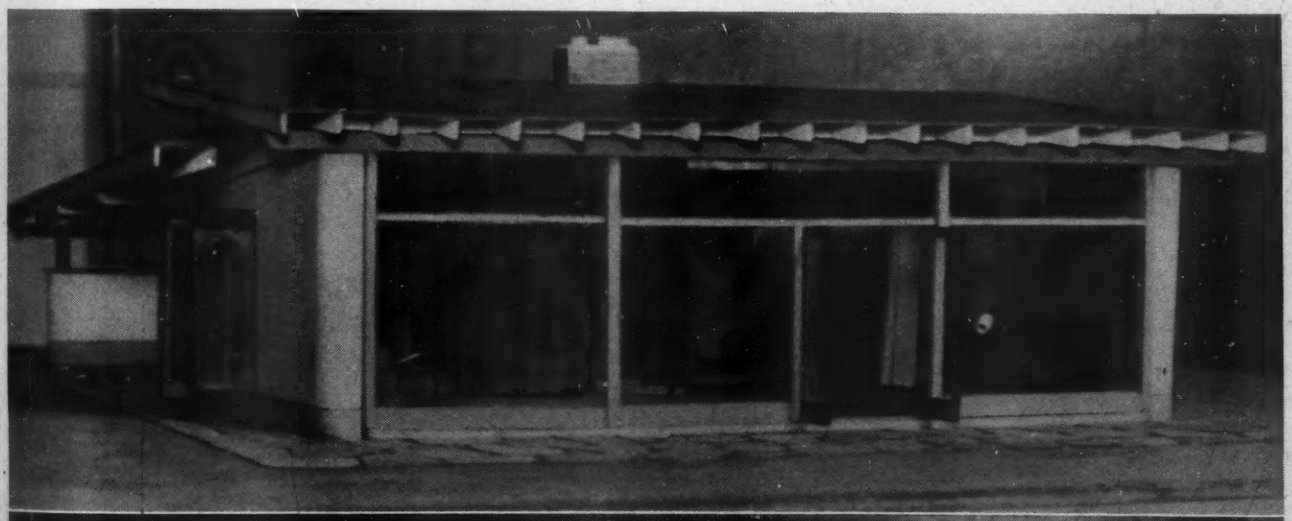
The compressed-air hammer that was used in building the experimental walls was a heavy paving breaker, which proved cumbersome as the level of the form rose progressively. The smaller, lighter backfill tamper would have been more efficient. As compared to hand work, the impact of the hammer blows was so strong that the form began to creep up during the tamping of the first 3-inch course, and at one time was knocked off. After some experience with the tool, the operator had no difficulty in controlling it, but he had to be careful not to nick the inner surface of the form with the tamper end. The form was of ¾-inch plywood with 2x4 outer framing and was coated on the inside with old crankcase oil to prevent the soil from sticking to and moisture from affecting the plywood. There was no visible difference in the appearance of the section rammed slowly and cautiously by hand and that tamped by the fast, powerful paving breaker. Speed of operation is definitely one of the machine's advantages, and all other phases of rammed-earth construction should be planned to retain this advantage.

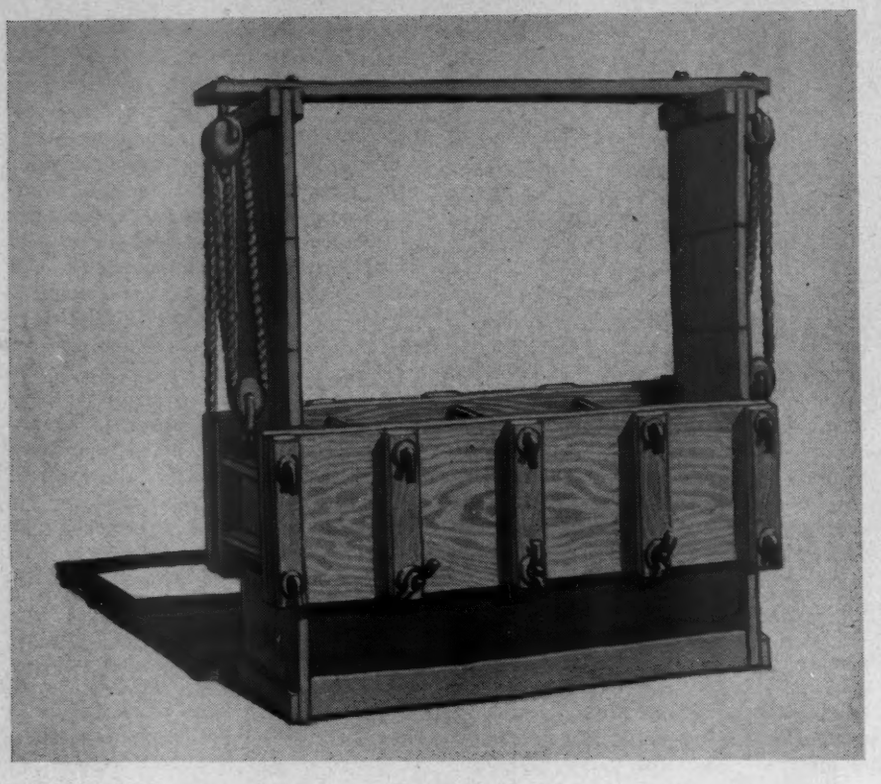
Work on the test project was sporadic, but Farmers Bulletin No. 1500 states that three men placed 54 square feet of 18-inch wall in a day by the customary hand method. At this rate, three men could put up the walls of an average small home in 7.03 days. The one pictured has 380 square feet of 18-inch wall. With pneumatic tampers, based on the figure of 7 cubic feet per man per hour by J. D. Long, Agricultural Engineer at the University of California, the time would be cut to less than half, or to 3.38 days. Figures are too pat—they do not always take into account the hundreds of things that can and do happen to upset them. But, even so, they are a basis of evaluation. Assuming double the period calculated, the time would still compare favorably with that required for the usual type of wall construction. This discounts the arguments raised against rammed earth on the score of building time.

In the case of the model house, the special form that was developed as a result of the test walls is as long as the piers—8 feet. The end gates are higher than the wall to be tamped and are held together by an overhead crosspiece. The sides are 2½ feet high and slide like tracks on the end gates on which the successive tamping courses are marked, thus making leveling automatic. A triangular piece of wood attached to each corner of the movable sides serves to

MORE VIEWS OF MODEL

At the top is the southern exposure, with the all-window wall. The other picture shows the car port.





RAMMING FORM

It is built of wood. The side pieces are of plywood and, when loosened, can be quickly raised to a new position by the block and tackle at both ends. The form is designed for ramming an 8-foot wall.

round off the corners of the finished wall. At each end of the form is a block and tackle by which both sides and cross-bolts are raised together. Complete removal of the sides between shifts is unnecessary, and even one-man operation is possible. By a simple camlike device, one pull permits either tightening or loosening the long bolts, thereby freeing the sides but not allowing them to come apart. The lower bolts extend completely through the wall and are withdrawn at each change. If the project is large enough, forms can be made of metal so long as they are not excessively heavy.

The whole house involves a total of twenty different shiftings and fillings of forms; and the highest wall is rammed in four sections which permit the loose earth to be handled from one platform on wooden horses half the wall height. This is an easy lift with a shovel before the soil is placed in the form itself for tamping. Quantity construction could take advantage of much of the earth-moving machinery that was developed during the war years, such as road levelers, large grapples, bulldozers, and hoist trucks.

The urgent need for homes and the obstacle of material shortages should lead to the large-scale use of this building medium. A vital structural item would thus be reduced to inconsequence as an undiminishable supply of earth is available at most sites. With up-to-the-minute pneumatic equipment for tamping the soil, and the employment of machinery to mold houses by the hundreds it is no longer good sense to think of rammed earth as a novelty. On the contrary, it is one solution of the present critical housing problem. This is particularly the case with the lower-income bracket where rammed earth has never competed with other materials and where the usual construction methods have meant no new construction at all.

BIBLIOGRAPHY

Adobe Construction. Bulletin 472, J. D. Long, University of California, Berkeley, Calif.

Pneumatic Tamping in Rammed Earth Wall Construction. J. D. Long, Agricultural Engineering, August, 1929.

Rammed Earth Walls for Farm Buildings. Bulletin 277, R. L. Patty. South Dakota State College Agricultural Experiment Station, Brookings, S. D.

New Hard Surfaced Floors. Circular 42, R. L. Patty.

Relation of Colloids in Soil to its Favorable Use in Pise Rammed Earth Walls. Bulletin 298, R. L. Patty.

Homes Built of Rammed Earth. C. H. Vivian. Compressed Air Magazine, March, 1927.

Soil-Cement for Low-cost House and Farm Building Construction in Rural Areas. (Mimeographed.) Portland Cement Association, 330 W. Grand Avenue, Chicago, Ill.

Soil-Cement Mixtures. Portland Cement Association.

Report BMS 78. National Bureau of Standards, Washington, D. C.

Terracrete. Francis MacDonald, Chestertown, Md.

TEST WALLS

Both walls are shown after two years of weathering. The one at the left is of medium-fair soil. The other one was given a 5 percent soil-cement veneer. The lower halves of both walls were tamped by hand and the upper halves with an air-operated paving breaker. A backfill tamper would be better suited for the work.

WILD YUCCA

Of the 30 known varieties of yucca, five grow wild on a vast area in the Southwest. In New Mexico alone there are 19 million yucca-bearing acres. In some sections the vegetation is heavy enough to yield 2¾ tons of fiber to the acre. When conditioned for use it is worth about fifteen cents a pound. Yucca requires very little moisture, as it obtains most of its sustenance from the sun and air. It is one of the few plants that grow on lava flows, where soil is virtually nonexistant. The variety shown above is yucca elata that bears New Mexico's state flower on its long stem. Other common species are yucca nolina, yucca glauca (bear grass), and yucca baccata (Spanish bayonet). At the left the author is seen examining a yucca plant.

New Uses for Desert Plants

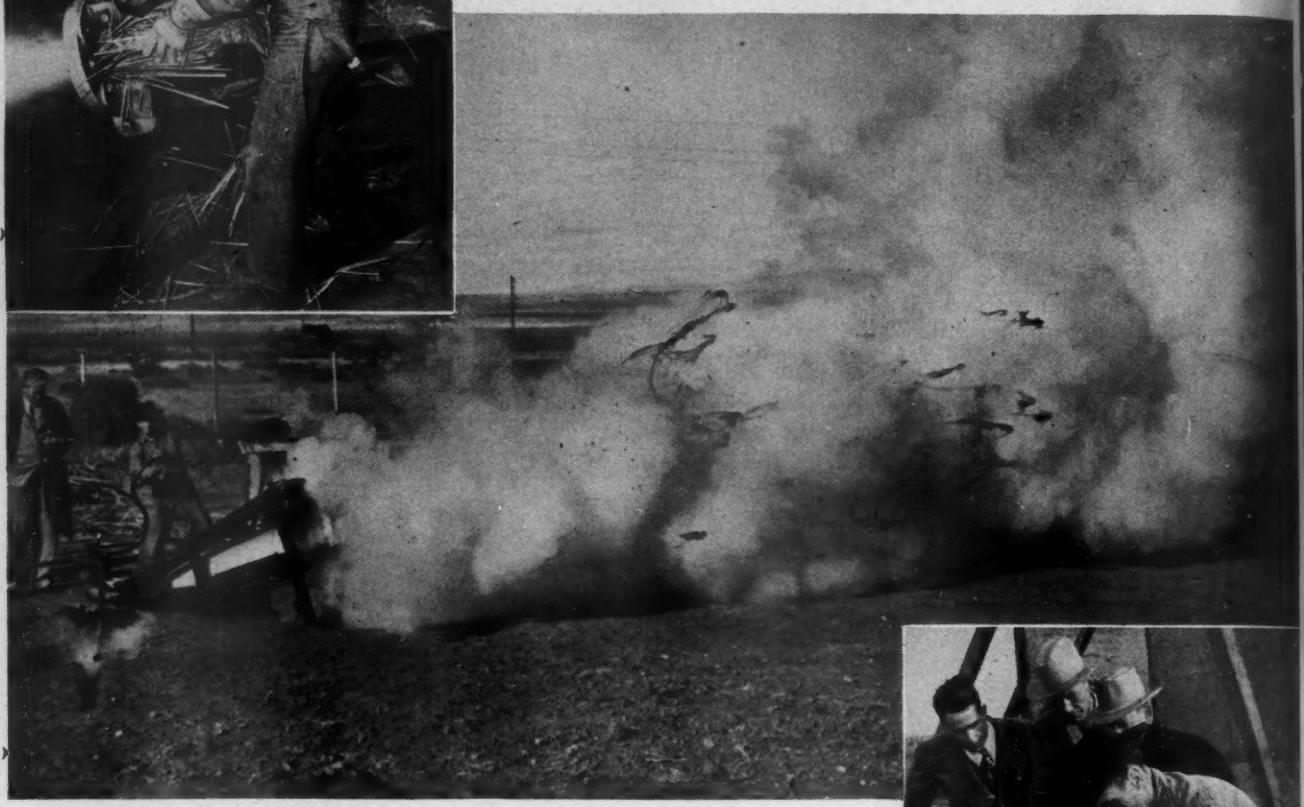
Fremont Kutnewsky

THE farther we go along the road of industrialization, the more we have to search and improvise to keep mills and factories provided with raw materials. Two recent global wars took heavy tolls of the world's available resources, not only of minerals but also of plant life. Meanwhile, new ways to use basic materials have multiplied. The theory and methods of mass production are scarcely 100 years old, and already we are beginning to depend on chemurgy to create and adapt many essential "raws." Among these are the desert plants that used to be nothing more than scenic settings for the enjoyment of tourists.

A year and a half after the end of World War II, American industry was still baffled by bottlenecks in supply and, among other things, looking for vegetable fibers, pulp, and tannin for varying needs. All these, now that necessity has mothered the research that led to their discovery, may be obtained in quantity from millions of uncultivated acres in the semiarid sections of the Southwest.

Shipments of grains, sugar, cotton, wool, and vegetables call for burlap and lots of it, but the sources of the material from which it is made were disrupted following the war. Shortages of jute from India, hemp from the South Pacific, and sisal from Africa began to affect the production of burlap, cordage, and padding in the fall of 1946. In consequence, interest was again centered upon the plentiful yucca of the Southwest whose fiber is equal to that of Manila hemp but difficult to separate from the heavy green leaves. Experiments with a high-pressure steam process of decortication indicate that only two things are required before industry can be supplied with this essential raw material, namely, processing plants, plus a practical method of gathering the leaves. It is estimated that there is enough wild yucca in New Mexico, Texas, and Arizona to keep one or several plants going until ranchers and farmers can be induced to grow yucca as a crop.

There is nothing new about the use of yucca fiber. Indians in the Southwest wore yucca-rope sandals and feather robes hundreds of years before the Spanish appeared in the area in 1540, while modern Indians produce bowstrings and matting. During the fiber shortage in the first world war a large quantity of yucca was manufactured into bags and cordage, and in the recent conflict it was made into a special paper for the U. S. Navy. Small amounts are in demand for stiffening the mud required in drilling oil wells. A type of rustic board of yucca fiber enters into the production of souvenirs such as albums for clippings and painted novelty greeting cards. And some beginnings have been made in New Mexico in the manufacture of yucca-fiber rope and brushes. Of the thirty known varieties of the plant, five



"SHOOTING" YUCCA FIBER

Based on the same principle that is used to puff cereals for our breakfast table, this apparatus strips yucca fiber of its pulp and gum by the action of expanding steam. Green leaves are placed in the muzzle (left), which is closed after a charge of 100 pounds has been loaded. Then steam is admitted, and in three or four minutes pressure builds up to 400 psi. A trigger is next pulled and the fiber shoots out (below). It is collected and washed (bottom)) and is then ready for various uses. These pictures were taken during an open-air demonstration last November at Lordsburg, N. Mex. The nonfibrous parts of the plant, which are believed to contain valuable chemicals, may be recovered on a commercial scale in factories equipped for the purpose.

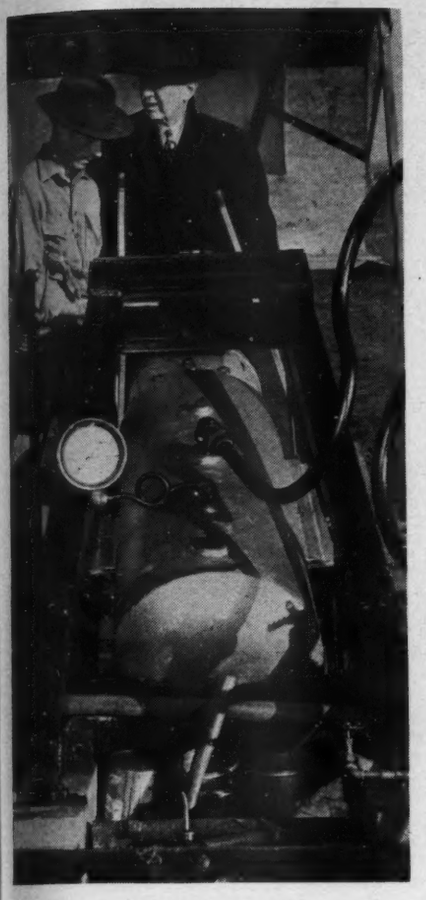
grow in the Southwest. They have different qualities, some are fine of fiber, some coarse, some long, and some short.

Up until 1946, the idea of yucca fiber being a commercial product had always been pooh-poohed by people who said that it took many years to grow the plant. This objection was answered once and for all when the New Mexico Development Foundation discovered records of German experiments with yucca. Seeds from New Mexico had been planted in that country and cultivated successfully. It took eleven months for the seed to become a sprout, and 21 months for the leaves to mature. There is so much yucca in the Southwest that it would not be necessary to start with seeds, for plenty of sprouts could be obtained from present stands. Inasmuch as only the leaves would be used for fiber, the lapse of time between harvests would be 20 to 22 months.

The U. S. Experiment Station at Las Cruces has found that four or five species of wild yucca grow more or less freely on some 19,000,000 acres of land in New Mexico. It flourishes where practically no other plant life can exist, for its sustenance is largely drawn from air and sunshine. Measurements of yucca stands in two locations near Silver City showed that an average of 9.7 tons of green leaf could be obtained per acre. Allowing for a 40 percent loss in drying, and based on a 48 percent fiber content in the dry leaf, an acre would yield 2.87 tons of fiber. This is equivalent to more than ten bales of cotton per acre. Detailed information on the subject is contained in Bulletin 300—*Fiber of Native Plants in New Mexico*—published in February, 1943, by C. W. Botkin, L. B. Shires, and E. C. Smith of the Agricultural Experiment Station of the New Mexico College of Agriculture and Mechanic Arts.

The new decorticating process was demonstrated at Lordsburg in November, 1946, and reminds one of the way puffed rice and puffed wheat are produced for our breakfast table. Green yucca leaves are jammed into a cylinder, the lid is clamped on, live steam is introduced, and a few minutes after a trigger is pulled the fiber shoots out. With a little washing in fresh water, it appears to be ready for upholstery or rope making. So far we have discussed only the fiber, but still more interesting discoveries followed quickly in the wake of the first serious investigation of yucca as a plant of considerable commercial possibility.

Juices from the plant, found in the water in which the fiber was washed and in the "steam gun" itself, represented all that was left of the green leaves and proved to have amazing chemical properties. Flotation mills are experimenting with one of the elements as a reagent; soap manufacturers are trying out the saponin content; another ingredient makes a fine boiler compound; and a fertilizer manufacturer has announced



YUCCA "GUN" AND INVENTOR
R. S. Chapman of Los Angeles (with crutches) is shown with his mechanic, J. Sibenhaar, and with the apparatus he devised to decorticate and degum yucca and similar plants by the sudden release of steam pressure.

that the juices contain two valuable vitamins.

It was at the suggestion of Sidney M. Weil, executive director of the New Mexico Development Foundation, that the study of yucca-leaf juices was undertaken. In the first place, Mr. Weil noticed that wherever the gun shot yucca fiber across an area 30 feet long and 20 feet wide, the bare ground was soon covered with fresh green grass. The time of the tests was the middle of November! He was also familiar with the century-old use of the yucca root as soap and shampoo by Southwest Indians, and with the fact that contemporary soap makers had discovered its merits. He knew, too, that Indians scoured wool with their "soapweed," an application that is now being examined by a yarn manufacturer. Not until Mr. Weil began to get laboratory analyses of the residue juices was it learned that the plant's green leaves have the same properties as the roots.

As a result of the findings, it is believed that yucca may be commercialized primarily for its juices and secondarily for its fiber. Oddly enough, when Mr. Weil inaugurated the present research program, he was looking for a tough fiber that would be suitable as a binder in a new kind of wallboard. It was proposed to use pitchstone, of which New Mexico has an ample supply, as the aggregate and yucca fiber as the binder. This work is continuing with a view to producing a wallboard that will not need a protective covering. The plan is to make it into sheets like pressed cork or Sheetrock Presdwood.

As for the pulp, that by-product may make yucca still more valuable in other ways. As has already been mentioned, it was converted into an excellent paper for the Navy during World War II. The expanding uses of paper in the manufacture of laminated containers and gears and dies, for example, call for new sources of pulp, and attention is now being directed towards other grasses, bushes, and plants of the Southwest. These would be self-renewing, like farm crops, while the forests now being cut down to keep our newspapers and great printing establishments going are slow-growing. Greasewood, river willows, and certain grasses are being investigated as possible raw materials. In fact, one paper and boxboard manufacturer has stated that New Mexico's wild plants would warrant the installation of some fifty small pulping plants whose products he would be glad to buy.

One of the most interesting developments in turning desert vegetation to account in an attempt to solve one of the nation's raw material problems has to to do with canaigre, another air-and-sunshine plant like yucca. Both are found in abundance on land that is good for little else but grazing, and their removal will be no loss to livestock growers. Canaigre is better known as wild rhubarb or wild pie plant. It grows a foot or two high and has broad heavy leaves. Its root, which is thick and beet-like and has a tannin content of approximately 25 percent, has served Indians from time immemorial for tanning leather.

Vegetable tannin is used in the production of heavy leather (sole, belting, harness, etc.) and light leather (shoe uppers, fancy articles, and bookbinding). Anybody familiar with the industry knows that it is plagued with difficulties in the matter of tannin. Oak bark served when requirements were not so great. Then the American chestnut came to the rescue, but this tree has been attacked by a blight that is destroying it. Then American tanners obtained quebracho bark from Brazil, but they have been using so much of it that the quebracho forests are being depleted. The U. S. Department of Agriculture has undertaken to make intensive studies of domestic sources of tannin. Jerome S. Rogers of the leather industry has been loaned to the department for the purpose, and in the spring of 1946 he suggested the canaigre root as a possible solution of the difficulty.

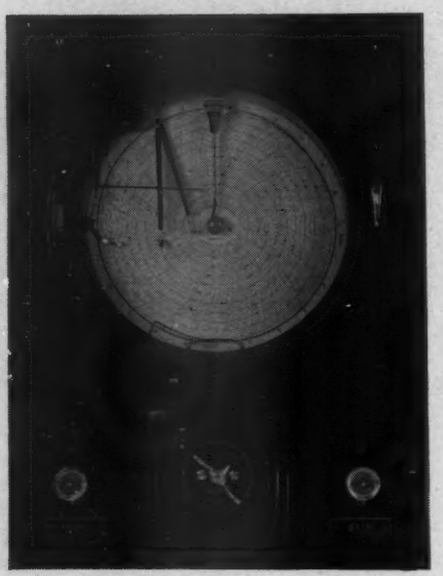
Attempts to put this root to use date back to the early 1890's. Quantities were shipped to tanneries in this country and in Europe, but before the tannin could be extracted from the roots they fermented. Transportation in those days was not what it is today, and diggers had to range farther and farther away from rail stations, thus increasing the cost of the raw material. Modern highways and trucks have overcome this drawback, and Mr. Rogers' ideas may make the canaigre root available as a source of tannin for the leather industry.

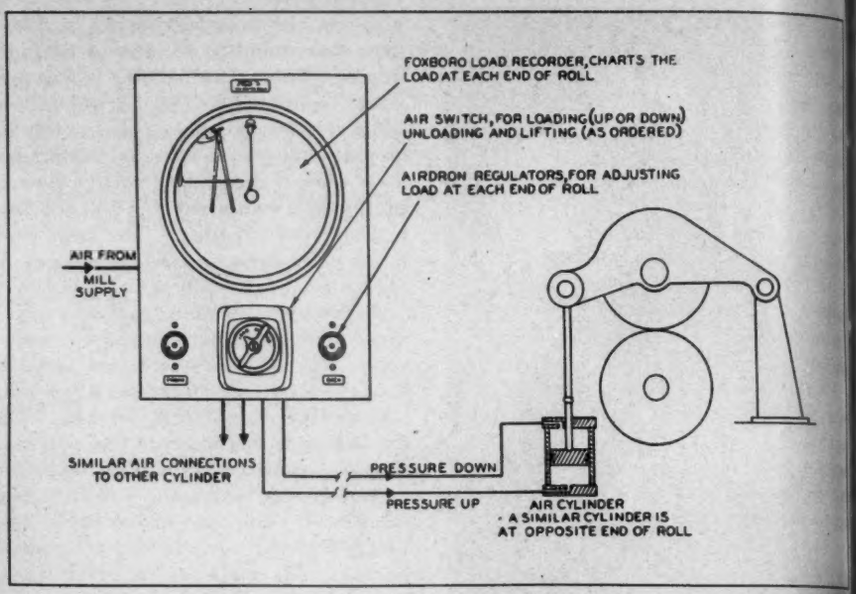
In view of the fact that the root contains the precious tannin but cannot be shipped satisfactorily, Mr. Rogers developed a process for its extraction at the site of harvesting. The Department of Agriculture has established experimental headquarters in southwestern New Mexico and is scheduled to demonstrate the process sometime this spring, using canaigre cultivated for the purpose and wild plants from across the state. Those farming irrigated areas in the state are interested in this effort to convert the old desert pest into a tame and profitable crop. It is not improbable, says Mr. Weil, that the root, after extraction of the tannin, may be useful either in the form of pulp or fiber.

A third variety of so-called "desert" vegetation that may one day be widely cultivated for commercial purposes is the candelilla. This plant is possibly a cousin of wax myrtle or candleberry, the waxy covering of which has been utilized in New England as well as in New Mexico for making candles, hence the name candelilla. It is also used in leather dressings, furniture and shoe polishes, varnishes, sealing wax, cement, electrical insulating materials, phonograph records, paper sizing, celluloid, paint removers, for water- and insect-proof containers, and as a substitute for carnauba wax and beeswax. Commercial demands for this domestic wax have recently shown considerable strength.

Today, the United States imports the bulk of its supplies of both vegetable tannin and fiber, as well as tremendous quantities of paper pulp. The industries that require these materials affect many other industries and most of us, who are consumers. If adequate sources of these important raws can be developed within the country we will have gone forward toward national self-sufficiency at a seven-league-boot pace. Cordage, bags, leather, and paper are vital to our economy. Looking at the movement from the other side of the fence, New Mexico and other southwestern states would be tremendously benefited by putting cheap, unproductive land to profitable use. New Mexico alone has 78,000,000 acres, of which less than a million is irrigated for crop production.

Loading Industrial Machinery Pneumatically




FOXBORO LOAD RECORDER, CHARTS THE LOAD AT EACH END OF ROLL
AIR SWITCH, FOR LOADING (UP OR DOWN) UNLOADING AND LIFTING (AS ORDERED)
AIRDRON REGULATORS, FOR ADJUSTING LOAD AT EACH END OF ROLL
AIR FROM MILL SUPPLY
SIMILAR AIR CONNECTIONS TO OTHER CYLINDER
PRESSURE DOWN
PRESSURE UP
AIR CYLINDER
A SIMILAR CYLINDER IS AT OPPOSITE END OF ROLL

SCHEMATIC DIAGRAM AND CONTROL PANEL

Compressed air from the mill supply line is piped into the control panel, where its pressure is reduced, as desired, by turning the Airdron regulators in the lower corners. Each regulator controls the pressure in one air cylinder, thus permitting different loading on the two ends of a roll. As the regulator dial is turned, the pressure is shown by a pen on the recorder in the upper part of the panel, thus enabling the operator to make the adjustment as close as he can read. There are two pens on the instrument, and they provide a permanent record of the pressure in each cylinder throughout the day. The charts serve as a running account of the day-by-day performance of the machine and can be referred to when it is desired to duplicate a setting that was made previously when similar material was being run. Where a permanent record is not wanted, a control panel may be had with two dial pressure gauges, one for each Airdron regulator. At the bottom-center of the panel is an air switch to turn the air pressure on or off. Another setting may be included for transferring the air pressure from one side of the cylinder pistons to the other to lighten or raise a roll.

IN CERTAIN industries, of which paper and textile making are the more important, it is desirable to maintain pressure on rolls in excess of that provided by their own weight. Pressure has traditionally been applied by means of weighted levers, screw-down devices, screw-and-spring mechanisms, or hydraulic systems. The Foxboro Company, of Foxboro, Mass., originated and, for a number of years, has offered a pneumatic method of loading that is claimed to do the job better than the other equipment. The manufacturer states that "Every advantage found in any other method is also found in the pneumatic method; but only the pneumatic method is free from the faults which are inherent in the others."

Pressure is applied to the rolls by pneumatic cylinders, acting either directly or through connecting linkages, as shown in accompanying illustrations. The cylinders may be built on to new machines when they are ordered or added to equipment already in service. Cylinders may be placed at either end or both ends of a roll, and where used at both ends they may be regulated to exert equal or differing pressures. The control instruments may be located near the machines or remote from them. Only simple settings are needed to actuate the controls, after which they function automatically. In fact, simplicity is one of the virtues of the system, and no special skill is required on the part of the operator. A diagram shows the different parts of such a system and explains how the pressure in the cylinders is controlled.

The advantages of the pneumatic method are chiefly attributable to the nature of compressed air. Air is not only safe, clean, and convenient to use but it can also be regulated under pressure so as to exert the precise "load" or "nip" desired. Once established, the load is maintained by a responsive, self-adjusting cushion and not by an unyielding mechanical device. This resiliency of air is important in connection with the operation of rolls that are out of round. Those made of or covered with yielding materials usually become slightly eccentric after a short working period. A roll may be out of round only a few thousandths of an inch but, unless the loading system compensates for it, the force exerted will vary considerably at different points in its revolution. If the service of out-of-round rolls is continued under locked-in pressure, the eccentricity will usually increase until recovering becomes necessary. Hard-surfaced rolls may develop washboard surfaces and have to be sent away for treatment. Pneumatic loading prolongs the time rolls can be used before they have to be removed, because the loading medium and not the roll takes most of the punishment.

Rolls loaded by screw-down devices or hydraulically are virtually locked in place and there is no "give" to compensate for variation in distance between the axis and the surface of each roll. Under these conditions, eccentricity must be taken up by the roll covering or by the material passing through the rolls. The loading pressure will vary according to the thickness and nature of the roll covering and of the material being worked and, under some circumstances, the variation may be greater than the load originally applied. If the material wads while passing through a machine, that may increase the load sufficiently to cause considerable damage. In the case of weight-and-lever loading, eccentricity of the rolls causes the weights to rise and fall with each revolution, producing a "chattering" effect that results in varying pressure.

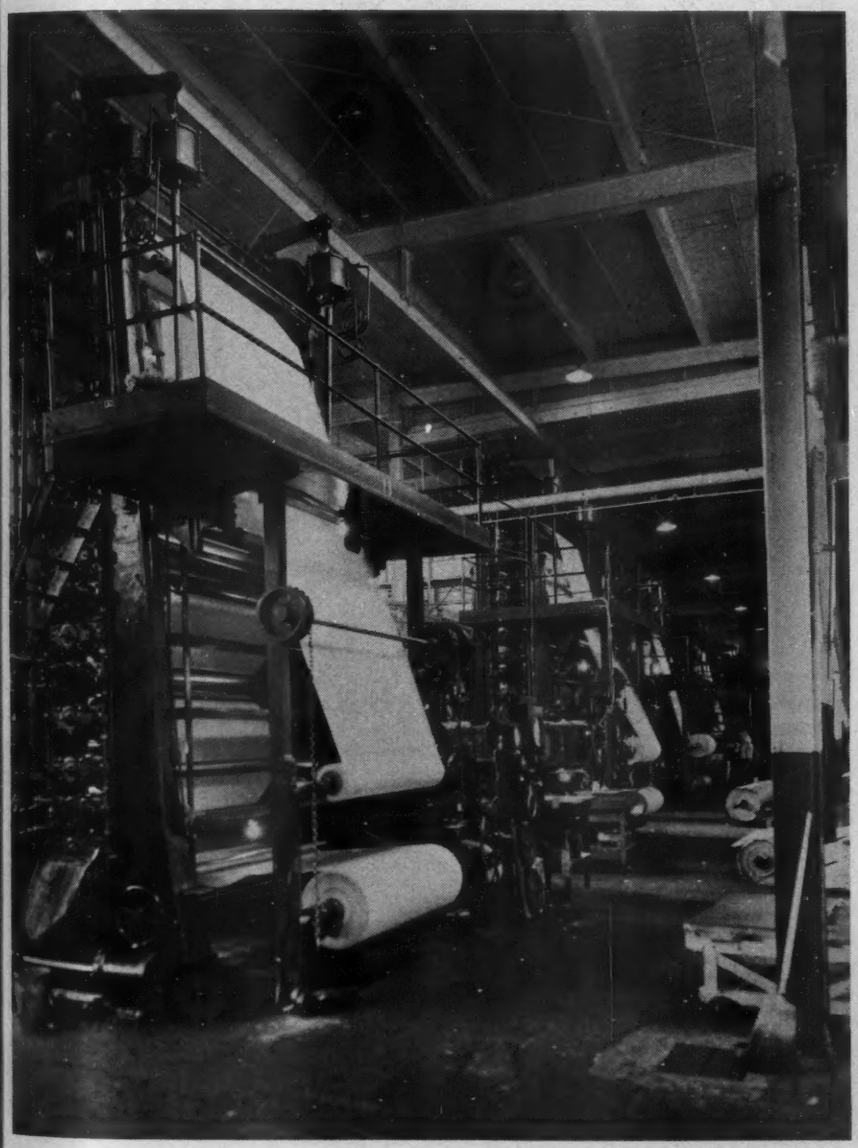
It is claimed that a pneumatic loading system works equally satisfactorily at all speeds of the roll machine. If a roll has a tendency to bounce at high

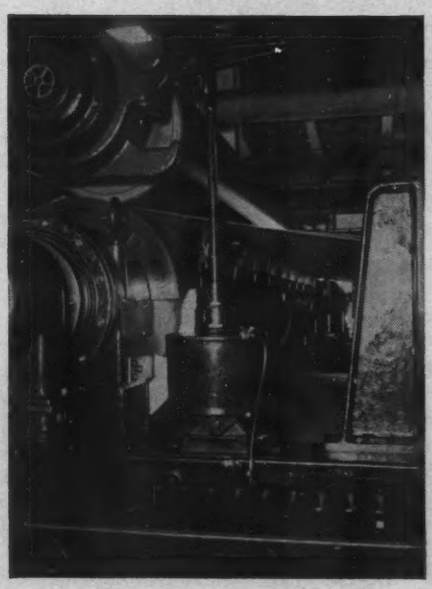
speed, pneumatic loading will snub it. Where there is a sequence of operations of which rolling is one, pneumatic loading may make it possible to run related machines faster. In a textile mill, for example, uniform dye penetration or uniform moisture extraction brought about through unvarying loading of the rolls may permit the drier that follows to be operated at higher speed because it need not be slowed down to take care of wet spots, which are often present when other types of loading are employed.

Work can be done more uniformly with pneumatic loading because pressure can be adjusted to give the best results for any particular run of material. Once the load is established, it is automatically maintained. When similar runs are to be made later, the same load can be applied by duplicating the setting shown on a recorder chart. Also, if a machine is unloaded during a run to pass splices or breaks in the material, the load that was formerly exerted can be instantly restored.

The air cylinders that apply the load are double-acting units. The turn of a switch releases the pressure on one side of the piston and unloads the system. Where desired, another setting of the switch may be provided to exert pressure on the opposite side of the piston and thus lift the upper roll free from contact with the lower one. This prevents idle rolls from developing "flats." Further, it is possible to tie in the loading system with the drive mechanism so that the load will be automatically relieved whenever the machine stops. In cases where the load to be applied is less than that of the upper roll, the weight of the latter can be lightened by exerting upward pressure on it through the air cylinders. A machine can thus be adapted for a wide range of work at varying loads.

Cylinders for different types of loading range from 3 to 16 inches in diameter. They are built to withstand pressures of 150 psi., although the air-line pressure in mills is generally within the range of 90-100 psi. Where the work does not require this full line load, the pressure is adjusted, as required, by Airdron regulators. Standard cylinders have a piston stroke of 6 inches, but special ones can be furnished with any stroke from 1 to 30 inches.





INSTALLATION VIEWS

Shown above are supercalenders in a paper mill, with air cylinders loading the rolls through levers near the tops of the machines. The cylinders are moored by means of pull rods. At the upper right is pictured a cylinder with an upward action on the pressure roll of a Yankee paper machine. At the lower right is a 14-inch cylinder on the second wet press of one of the world's largest paper machines. It and its companion at the other end add a load of approximately 12 tons to the 10.2-ton dead weight of the upper roll.

Mobile Drill Sled for Slope Quarrying

W. C. Coe

TO MINIMIZE the accident hazard and at the same time increase operating efficiency, a sled that could be moved about on a steeply sloping quarry face was utilized for drilling and blasting riprap material for the Blue Mountain Dam near Booneville, Ark.

The dam is a rolled-fill earth structure that is being built by U. S. Engineers on the Petit Jean River at a point 76 miles upstream from its junction with the Arkansas River. It will be 2800 feet long at the crest, with a maximum basal thickness of 830 feet and a maximum height of 120 feet above the foundation. A spillway will be located in a low saddle in the left abutment and about 400 feet downstream from the dam's axis.

Outlet works for controlling the level of the water in the reservoir will consist of a conduit in a tunnel, 1032 feet long and 20 feet in diameter, through the right abutment; of an intake structure at its upstream portal; and of a stilling basin at its downstream end. When

THE SLED IN SERVICE

1– The sled on the quarry face, showing light construction that permitted it to be moved easily. 2– Close-up of the drill and the air hoist on the front of the sled that served to raise or lower the unit as desired. 3– The quarry face, with the sled spotted in the circle. 4– A view down the quarry face showing the sled and a power shovel loading broken rock. 5– Upstream face of Blue Mountain Dam with most of the protective sheathing of riprap in place.

filled to the level of the spillway crest the lake behind the dam will extend upstream for 19 miles and have a maximum width of 2 miles and a shore line of 89 miles. The water surface will have an area of 11,000 acres. The estimated total cost of the undertaking is $5,000,000. The general contractor is the S. E. Evans Company of Fort Smith, Ark.

The work involves the transportation and placing of approximately 700,000 cubic yards of rolled embankment, the excavation of 280,000 cubic yards of earth and 23,000 cubic yards of rock, the pouring of 10,000 cubic yards of concrete, and the use of 300 tons of reinforcing steel. The dam will have an upstream section of selected impervious material, a transition section of random impervious material, and a downstream section of pervious material.

A 3-foot layer of dumped riprap is being placed on the sloping upstream face to protect it from erosion by wave action. The riprap was obtained by opening a quarry near the dam site where a side-hill cut had been made for a road. The rock is bedded and dips at an angle of 45°, and the working face consequently assumed the same slope. The exposed top layer varied in thickness from 8 to 16 feet, and to get the stone out as desired it was necessary to drill the blast holes perpendicular to the sloping face.

One way of drilling the rock would have been to lower men from the top of the hill by lines and with safety belts. However, records of operations where this had been done show a rather high number of lost-time injuries. That method is not only arduous for the workers but also slow because it must be carried out with relatively small hand-held drills. The cost of stone production is therefore high.

All these objections were overcome by the contractor in devising a sled-type drilling rig which was constructed so that the working platform would be horizontal when the runners rested on the 45° slope. The sled was 13 feet long, and 6½ feet wide, and the runners and frame were made up of 2-inch pipe welded into an integral structure. The platform was 2 feet 8 inches wide by 6 feet 5 inches long and built of ½-inch hardwood boards. It was hinged at the front, and the height at the back was made adjustable by supporting it on a 2-inch pipe that telescoped into a 2½-inch pipe. This permitted keeping the floor level regardless of variations in the slope of the rock face. A guardrail of ¾-inch pipe was placed around the platform.

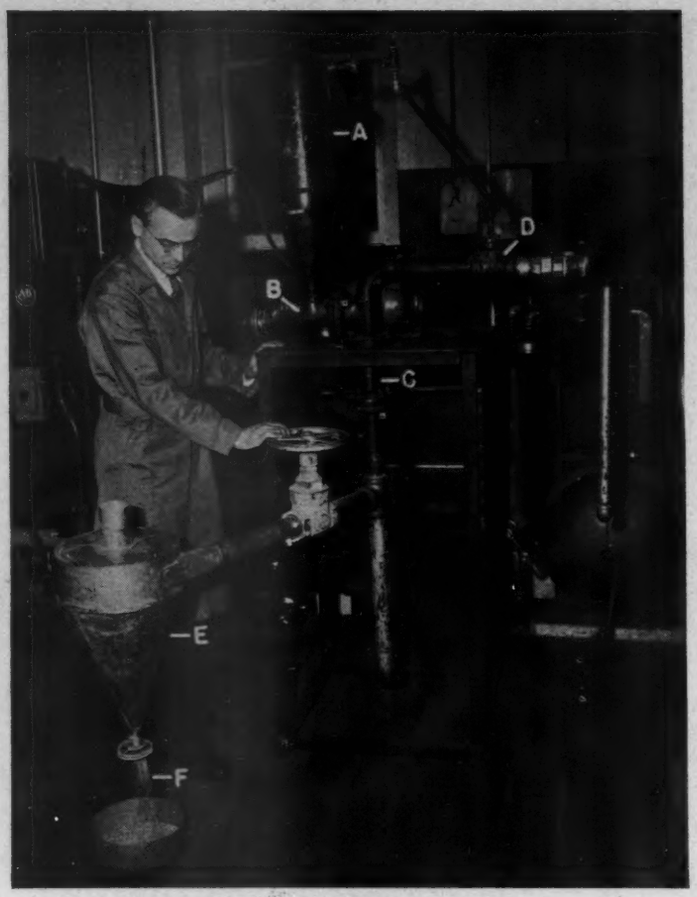
Projecting forward from the sled was a V-shaped tongue made of 1¼-inch steel rod. It was attached to the corners and prevented the structure from turning sidewise when it was being moved up or down the quarry face. On the front end of the sled was mounted an air-operated hoist with a 24x6-inch drum that held 400 feet of ⅜-inch wire-center, improved plow-steel, preformed wire rope. Preformed rope was used because it spools better than ordinary wire rope and because it provides an added safety factor. Even when worn it does not flare and can be handled without danger of hand snags.

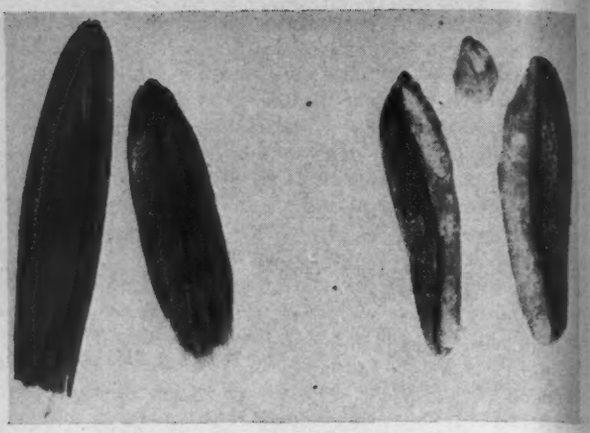
This rope was run up to the top of the cliff where it was passed through one side of a double sheave block, then back to a single sheave block fastened to the tongue of the sled, up the face again and through the other side of the sheave block, and finally down to a dead end at the sled. The sheave block at the top of the quarry was attached to a crawler-type tractor, which was moved along the crest as desired. Mounted on the tractor was a 500-cfm. air compressor from which a 1½-inch delivery line extended to the sled. There it was connected to a manifold having four outlets with hose take-offs leading to the drill, to the air hoist, and to a blowpipe used for cleaning holes during and after drilling. The fourth outlet was a spare to serve a hand-held drill or any other pneumatic tool.

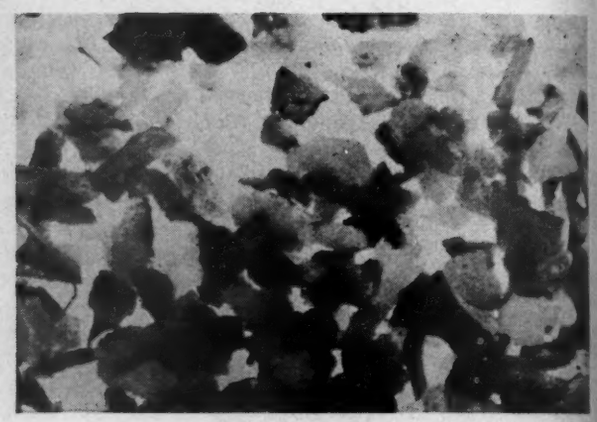
With one operator on the platform, the sled weighed about 850 pounds, being light enough to permit him to move it laterally with a pinch bar. The hoist was powered by a reversible air motor, and the operator moved the sled up or down by either winding or unwinding the wire rope on the drum. As a safety measure, for use in case of an emergency, the hoist was provided with an outside drum hand brake.

The drilling unit on the sled was an Ingersoll-Rand DA-35 drifter mounted on a tower. The latter was taken from one of the FM-2 wheel-mounted outfits that are extensively utilized today for quarrying, roadbuilding, and for general heavy excavating. Because the tower is equipped with an air motor for raising and lowering the drill, the work could be done with hardly any physical effort on the part of the operator. The DA-35 is much more powerful than the largest of the hand-held types, so the sled idea resulted in much faster drilling than could have been accomplished by men suspended from ropes. The tower was set up on a swivel attachment that permitted directing holes on any desired angle. Drilling was done with detachable bits, and a steel box across the rear of the sled provided space for spare rods and bits.

The success of the apparatus in promoting safety is shown by its record. More than 40,000 cubic yards of rock for riprap and more than 8000 cubic yards for crushing were produced with only a few minor injuries, none of which involved any lost time. There was no accident, and the equipment sustained no damage.







ROLLERLESS GRAIN MILL AND SOME OF ITS PRODUCTS

At the left is a view of the laboratory apparatus in which cereals and legumes are reduced to fine particles by the explosive action of compressed air, the degree of reduction depending upon the amount of pressure used and the time it is applied. The material is fed continuously from the hopper *A* to the high-pressure air stream at *B*. The air is supplied by the compressor on the right through pipe line *D*. Within the housing *C* is a nozzle where the pressure is suddenly released, causing dissociation of the grains. The particles are removed from the air stream in the separator *E* and emerge ready for segregation into husks, bran, germs, and flour. The picture at the upper right shows an oat berry that has been popped out of its husk and also the berry split apart with the germ removed. Below it is a magnified view of wheat endosperm and bran ready for separation and further pulverization of the endosperm into flour.

Exploding Cereals with Compressed Air

A NEW process for exploding cereal grains and legumes by means of compressed air or other gases has been announced by the Midwest Research Institute of Kansas City, Mo. The institute terms the procedure "explosive dissociation" and states that it appears to offer possibilities of improving grain-milling practices because it provides an easy way of separating the component parts of wheat, oats, grain sorghums, and similar field products.

The material is fed into a pressurized air stream, and some of the air penetrates into pockets within the individual grains. Passing through a nozzle, with sudden release of the pressure, the grains literally explode and are shattered. By varying the pressure and the pressure-contact period, it is claimed that almost any degree of segregation can be obtained. With low pressure and a short contact period, oat hulls are removed from the berry without harming the latter. Application of a somewhat higher pressure for a longer time results in splitting the oat berry and removal of the germ. With still higher pressure, oats or any other grains can be pulverized.

In principle, the scheme is akin to that used by John I. Yellott of the Institute of Gas Technology, Chicago, Ill., in devising equipment for pulverizing coal to serve as fuel in gas-turbine-driven locomotives (COMPRESSED AIR MAGAZINE, October, 1946, page 279.) The action in the two cases, however, is not the same. Coal, being homogeneous, is pulverized by the flash process. Cereal grains, on the other hand, are composed of differing structural parts which, as just mentioned, can be dissociated in varying degrees or pulverized, depending upon the control exercised.

The Midwest Research Institute has conducted experiments with a laboratory set-up for many months and has applied for patent rights on the apparatus. It is now planning to build a $100,000 pilot plant at the institute in coöperation with cereal processors to test the procedure on a commercial scale. It will be designed for continuous operation and will have a series of explosive dissociaters through which the grain will be cycled, with suitable segregation between steps. The end product will be flour and its by-products, or the equipment can be regulated to remove any of the component parts of the grain.

Whole-wheat, germ-free flour has been prepared experimentally and been baked into bread. Countless tests have been run to determine the effects of humidity, rate of feed, time of pressurization, and pretreatment of grain with enzymes and other substances, and studies are now being made of the effects of temperature and of active and inert gases used in place of air.

This and That

Coal-Mine Fire Going Since 1884

An underground coal-mine fire in the Hocking Valley of Ohio has been burning for 63 years and has now reached such proportions that the Federal Government is being asked for funds to fight it. Ineffective efforts to extinguish it were described in these pages several years ago. The flames have now consumed some 50 million tons of coal and, if not checked, will probably burn for at least half a century longer.

★ ★ ★

Pioneer Engine Found

McGill University in Canada has recently been given a model of a steam engine that is well over a century old. It has been identified as an oscillating-cylinder engine that was first made by two British firms. It was designed for paddle-wheel steamships, and especially those of shallow draft because the elimination of the connecting rod permitted fitting it under the paddle-wheel shaft. It used steam at a pressure of not more than 30 psi. It is believed that the model was brought to Canada from England in the early 1800's by Thomas McKay, a contractor on the Rideau Canal then in course of construction. In Ottawa he built Rideau Hall as his residence. Later on he sold it to the Dominion government to serve as a home for the governor-general. The model was recently found in the stables on the premises and was turned over to the War Assets Corporation for disposal. When put up for auction, it was bought by the Sendel Electric Products Corporation, which donated it to McGill.

★ ★ ★

Goldsmith Honored for War Effort

Dr. Lester M. Goldsmith, chief engineer of the Atlantic Refining Company, has received the decoration for exceptional civilian service for his contribution to the widely publicized "Operation Pluto"—laying of an oil pipe line under the English Channel preceding the invasion of Normandy. The award is the highest honor the War Department can confer upon a civilian.

Early in 1943, Doctor Goldsmith and Col. John R. Leavell, originator of the idea, proposed running a line of 4-inch seamless tubing, welded into 4- to 5-mile sections, across that waterway. They suggested laying it from boats and then joining successive lengths underwater with short flexible "grasshopper" couplings. In November, 1943, Doctor Goldsmith was made consultant to the Chief of Engineers in developing this project. The British concurrently suggested braided lead cable spooled from huge drums, and their plan was adopted. Doctor Goldsmith was allotted the task of specifying equipment and was also responsible for the design of the pumping stations. After doing this work in America, Goldsmith was sent to England to assist in planning the pipe laying. He expedited consummation of the scheme by arranging to have much of the piping made in the United States. His "grasshopper" connection was used to join the land and sea sections of the line on the English and French shores.

★ ★ ★

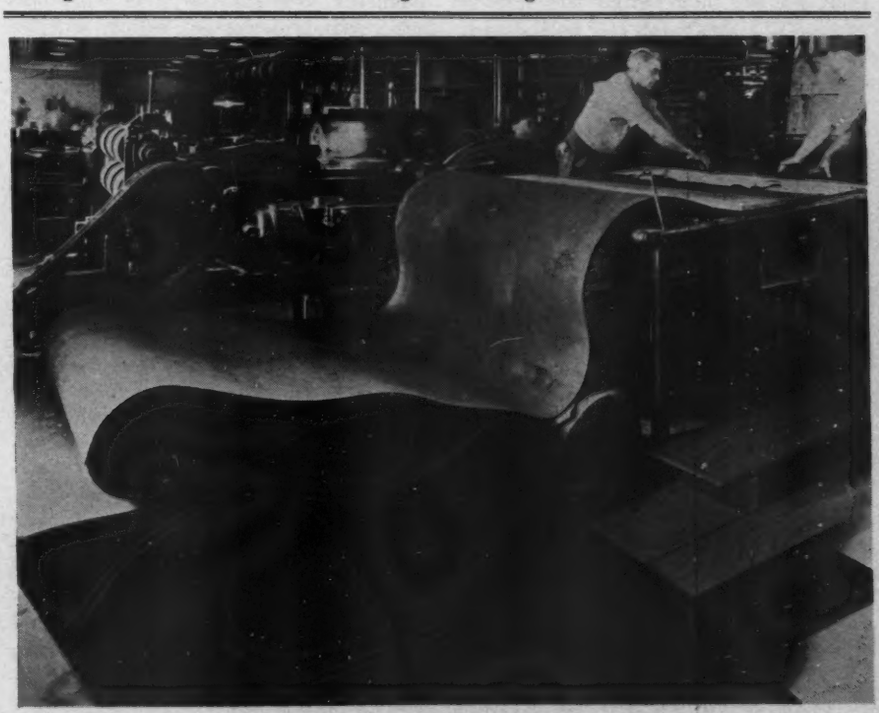
Europe's Coal Plight

Restoration of a normal economy in the various countries in Europe is being greatly delayed by the coal famine. Prior to the war, coal imports totaled 73 million tons annually, but they were supplied entirely by neighboring nations. Germany contributed 40 percent, Great Britain 32 percent, and Poland 10 percent. Germany now meets 15 percent of these requirements, but Great Britain and Poland export no coal. The annual deficit is placed at 52 million tons. Twenty million tons of this has been met by the United States, which has kept 500 ships busy transporting the commodity an average distance of 3000 miles. Shortage of food, materials, and manpower, as well as absenteeism, are called the major obstacles blocking greater European production. France still has 50,000 German prisoners in its collieries and wants to keep them a year longer. Poles are doing a good part of Belgium's mining. The western fields of Germany are producing some 200,000 tons daily, or at about 46 percent of the prewar rate, and are said to be in need of 100,000 additional miners.

★ ★ ★

British Furniture a la Carte

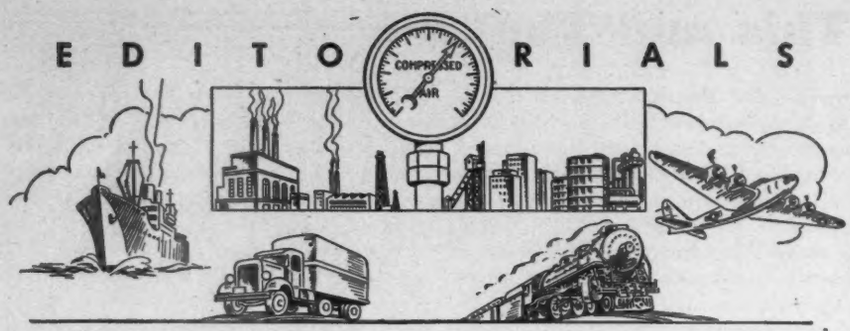
Instead of supplying finished furniture to Great Britain as it has in the past, Canada will begin this spring to ship it piece by piece. More than $2,000,000 worth of orders will be filled under the new plan, and large and small shops in Ontario will share in the work. Rough-sawn, dimensioned table and chair legs, crosspieces, braces, and supporters from those sources will be funneled to Montreal for bulk transportation overseas. The initial 3-months' contract calls for parts for 60,000 sideboards, 36,000 settees, 72,000 chairs, and 60,000 tables. This plan will save considerable shipping space, cut down the amount of money Britain must export, and provide employment abroad in assembling and finishing the articles.



BELT OF NEAR-RECORD SIZE

After several years of steel-mill service, this big leather belt is shown in process of repair in E. F. Houghton & Company's Philadelphia plant, where it was made. Of 3-ply construction, it is 106 feet long, 72 inches wide, and $^{9}/_{16}$-inch thick, and is one of the largest leather belts ever built. Parts of the hides of nearly 200 steers entered into it.

EDITORIALS



HEALTH IN INDUSTRY

INDUSTRIAL safety programs have two distinct aspects. The one that has thus far received most emphasis is the protection of workers against injury. Much has been done in this respect, and both management and labor know that "it pays to be careful."

The other phase of the safety movement is that of keeping people well. Illness causes much more lost time than accidents, yet it is regarded less seriously. Many wage earners trust largely to luck in avoiding sickness, evidently subscribing to the theory that the gods of chance control such things. The common cold takes a tremendous toll of time in shops and offices each year, sometimes assuming epidemic proportions, but the average worker does little to prevent it. Management can do only so much about this problem, because it can't regulate people's lives while they are off the job and can do little more than advise them while they are at work.

Real progress is being made, however, in combating occupational diseases, with a good and growing measure of cöoperation between management and employees. Medical research is the basis of the preventive efforts and is unearthing much information that can be put to beneficial use. Remedial steps are frequently found to be very simple. For example, The Safety Research Institute recently determined that a balanced diet is of great aid in warding off ailments (usually affecting the liver, kidneys, and blood) sometimes incurred by those handling metals and chemicals. Assuming that working conditions provide reasonable safeguards against contamination, it has been discovered that sickness is not likely to occur among those who get adequate amounts of proteins, minerals, and vitamins in their food. Investigation of the circumstances attending the illness of a number of women who were working with an organic solvent disclosed that all of them had been following a diet high in fat and low in protein and minerals. Their co-workers who had been eating balanced meals did not become sick.

Milk, which is rich in proteins and minerals, especially calcium, is considered the best protective food in industries of that kind. Tests have shown that liver poisons administered to animals do most damage when the subjects get little calcium. Some authorities recommend that a quart of milk daily should be included in the food of workers who handle lead, chlorinated solvents, or hydrofluoric acid. Various vitamins that can be obtained from fresh vegetables and fruits also are believed to be important protective agents against the effects of some industrial chemicals. Doctors advise against immoderate drinking, as alcohol in the system apparently increases the susceptibility to chemical poisoning. The recommended diet for those working with potentially harmful chemicals is one that is low in fat, high in protein and carbohydrates, and adequate in minerals and vitamins.

With more light being shed on the manner in which various harmful substances attack the human body and on the combative qualities of different food elements, perhaps the time will come when diet prescriptions will be as common and as important in industrial plants as safety equipment is today.

PAPER-MAKING MILESTONE

IT WAS just 80 years ago this spring that the American paper industry learned how to produce newsprint from wood pulp. As all paper was then being made from rags, this development greatly reduced the cost of printing. It also accelerated the growth of the paper-making industry. Nowadays, most of our paper is manufactured from wood pulp and, in addition, vast quantities of newer products such as paperboard. The output of newsprint alone totals more than 5 million tons annually.

There had been some sporadic efforts to make paper from wood prior to the successful pulping venture, but they were small-scale experiments. In 1830 the Crawford (Ohio) *Messenger* printed a single edition on paper produced from wood shavings. In 1863 the *Boston Journal* did the same thing, using paper made from wood reduced by a chemical process that did not prove practicable.

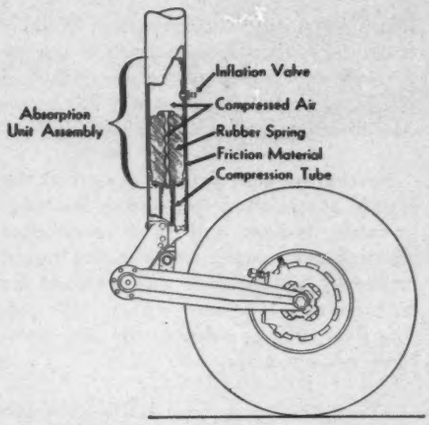
The first satisfactory wood-pulp sheet was produced on March 18, 1867, at Lee, Mass., by the Smith Paper Company, which then had five mills there, as it has today. It was made of groundwood turned out by a mill in nearby Curtisville with the aid of machinery imported from Germany. The accomplishment culminated more than a decade of endeavor by the paper-company proprietors, Elizur Smith and Cyrus West Field. As early as 1854 a Frenchman named Mellier interested them in a machine he had invented to convert wood into a suitable paper-making material. He actually produced some usable paper from basswood, but it left much to be desired, and the process was expensive. Elizur Smith's son Wellington, entered the business in 1865, and the problem with which his elder associates were struggling attracted him. Newsprint was then selling at 24 cents a pound as compared with today's price of around five cents, which is about double the prewar figure. Wellington Smith set Prof. Paul Chadbourne of Williams College to work trying to make paper stock by filing and scraping wood underwater. The process was patented, but found unworkable.

Meanwhile, in Germany, a papermaker and a paper-mill mechanic, Gottfried Keller and Heinrich Voelter, were approaching the problem by studying wasps' nests. By grinding wood they obtained a pulp somewhat similar to rag pulp, although lacking its strength and toughness. When a small quantity of rags was added they found that they had a raw material that could be converted into paper of satisfactory strength and that would quickly absorb printing ink. Voelter then invented a machine for reducing wood to pulp.

News of these developments reached Theodore Steinway, the American piano manufacturer, and he was interested in the possibilities of turning the process to profit in this country. He took the matter up with two of his friends, Albrecht and Rudolph Pagenstecher, and the latter was sent to Germany to investigate. He bought two of Voelter's machines, and they arrived in America late in 1866 with Frederick Wurtzbach, a mechanic, who improved the machine and greatly increased its effectiveness.

In the meantime the Pagenstechers had told Wellington Smith what they were doing and enlisted his support. They built a pulp mill at Curtisville, and by March had obtained a product of a grade considered good enough to try out. It was hauled in hogsheads to the Smith paper mill and there made into newsprint. After some further experimentation, a paper was produced that sold for much less than rag paper and that was in demand by newspapers. Two of the Smith mills were devoted entirely to its manufacture. From this beginning the process spread to other mills, and by 1880 the supply of the new paper was sufficient to permit virtually all the nation's newspapers to use it.

Airplane Landing Gear with Pneumatic Cushioning Unit



AIRPLANE LANDING GEAR
In the sectionalized view, the Superflex Undercarriage is shown in its extreme deflected position under maximum overload impact in which the rubber spring is compressed so tight that, together with the friction material, it forms a solid braking surface against the strut wall. This cushions the force of the landing and controls the recoil or plane's tendency to bounce.

FOR planes weighing less than 3000 pounds, The Firestone Aircraft Company is manufacturing an undercarriage complete with wheel, tire, landing gear, and brake—a packaged unit—that is said to be the most important advance in airplane design within the past few years. The outstanding feature of the undercarriage is the patented shock-absorbing unit which depends for its effectiveness upon the resilience of natural rubber and the cushioning action of compressed air.

Telescoping tubes, oil valves and compartments, and packing glands are eliminated in the new construction, and with them the danger of sticking and jamming during compression or extension. Instead, the initial impact of landing is absorbed by a rubber cylinder filled with compressed air, while rings of a special friction material, patented by Firestone, act as brakes and control the tendency of the plane to bounce as it taxies to a stop.

Another advantage claimed for the Superflex Undercarriage is economy of up-keep. There are no parts or fittings to wear out, consequently maintenance is confined to checking the air pressure in the rubber cylinder. In addition there is a saving in weight not only in the landing-gear assembly but also in the fuselage and wing structure that support the assembly. At present, the unit is being produced in three sizes suitable for nearly all types of airplanes under 3000 pounds; but undercarriages based on the same principle are being applied to increasingly larger craft. The assembly is said to be easy to install and meets all CAA requirements for overload landing impacts.

Tube Both Heats and Cools Air

A HOT-COLD pipe that converts ordinary compressed air into both hot and cold air without the aid of moving parts has been built by Westinghouse research engineers for study purposes. As yet they have no plausible explanation of the phenomenon, although it is conjectured that it may be attributable to the frictional effect of air currents moving at different velocities.

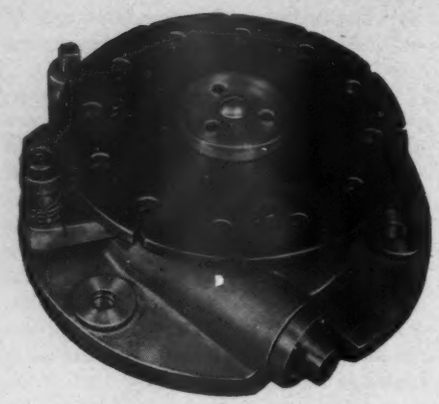
Compressed air is admitted at one end of the pipe through a nozzle that causes it to strike the inner wall tangential to its diameter, thereby creating a whirlpool effect. The air in the center becomes cold almost instantly, while that along the periphery gets warm. The cold air is drawn off at one end through a small opening in the center, and the warm air from the outer space.

The tube was invented by R. Hilsch of Germany. Using a pipe 3/10 inch in diameter, he claims to have obtained simultaneously jets of air at 154° and 10°F. The Westinghouse model, which is illustrated here, was purposely constructed larger to facilitate instrumentation for study purposes. It is 1 inch in diameter and 15 inches long, and gives a temperature difference of only a few degrees.

The Westinghouse announcement states that "low efficiency rules out commercial application at this time, but like the 'blue glow' in Edison's experimental electric light that led to his invention of the first electronic tube, it may lead to unexpected developments. Even now it holds promise as a handy laboratory tool for making cold as simply as a Bunsen burner produces heat."

PUZZLER FOR SCIENTISTS
Here is the pipe that produces both hot and cold air at the same time. As set up, compressed air is being admitted at the right end. Cold air is issuing from the same end and warm air from the left end. Gauges indicate pressures. The pipe is being operated by Warren Witzig of the Westinghouse Research Laboratories.

Industrial Notes



Punch and drill presses, milling and other machines not equipped for automatic or semiautomatic operation can, it is claimed, be quickly converted into machinery of this type by attaching a pneumatic Allen dial feed table. The index plate of the unit has holes or recesses machined in it in accordance with individual requirements and rotates on top of a steel rider plate. It is moved to and locked at each station by a pawl connected through an arm to a cylinder piston that is actuated by a cam-operated 3-way air valve controlled either by hand or a timing mechanism. When the valve is released, a spring allows the pawl to return ready for the next indexing stroke of the piston. In the case of a punch press, for example, the feed table is mounted on the bolster plate, the cam is located on the left end of the crankshaft, and the air valve is bolted to the press frame. Parts to be staked, pierced, or assembled are placed in a recess of the index plate, operated on at each stroke of the press, and carried to the next index position. Finished work may be ejected by an arm attached to the ram or by compressed air blowing upward into a lead-away chute. Table is said to remain accurate for millions of cycles because the locking means employed automatically compensates for wear.

Winding of long extension cords without tangling is the purpose of a reel put on the market by Benjamin Reel Products, Inc. That now in production takes 25 feet of 110-volt, 8-ampere appliance cord, which is pulled out as far as desired and locked in position by a ratchet. Release is effected by a slight tug on the line, which then retracts evenly and automatically, it is claimed. All parts are rustproof, and rubber suction cups on the bottom hold the reel during unwinding.

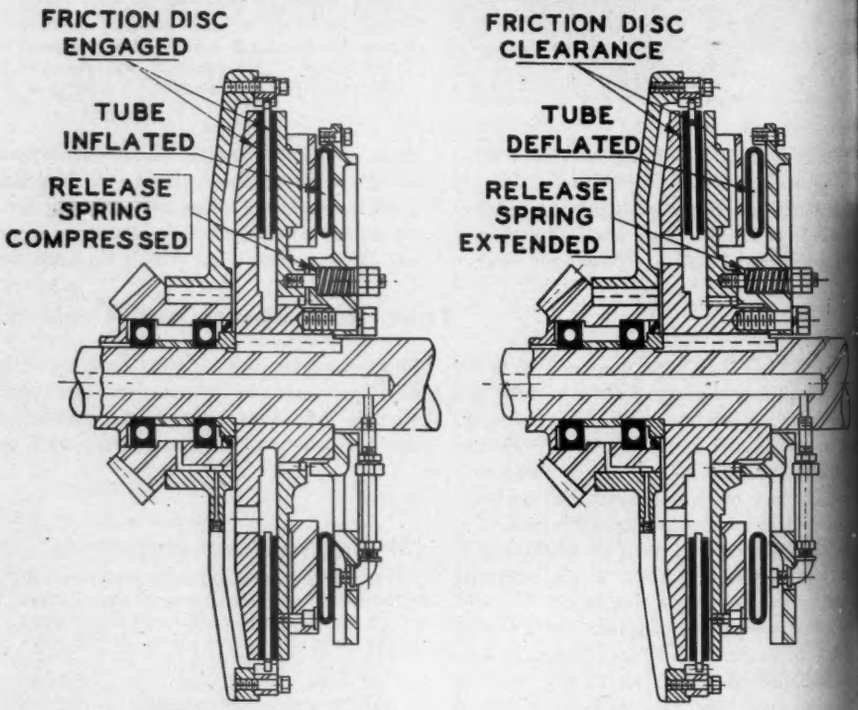
Objects that drop off racks during electroplating operations can be easily retrieved by placing on the bottom of the tank a special screen mounted in a frame for raising and lowering. Made of a plastic material, the screen is not affected by and does not contaminate the solution claims the maker, Chicopee Manufacturing Corporation.

Several months ago we described the Hydro-Matic Plug for sealing openings in tanks, boilers, and other receptacles that require testing under air or liquid pressure. That device was designed for high-pressure service—up to 500 psi. The new plug is suitable for test pressures not exceeding 100 psi.

Paradoxically, a very hard, abrasive substance makes the best compound for polishing fine watch parts. It's the industrial diamond, pulverized and carried in suspension in a paste with high clinging properties, which does this fine work and is now recommended for service in other fields of precision manufacture and for giving the necessary high finish to molds used in shaping plastics.

Bailey Meter Company is now printing its recorder charts in neutral gray because that tone emphasizes the colored inks and makes reading easier.

It has been reported that Germany exceeded all other countries combined in the production of powdered metals during the war. More iron powder was used there in a month than we made in a year. Equipment by which Germans produced hard cemented carbides by a hot- rather than our cold-press method has been shipped to Stevens Institute of Technology in Hoboken, N. J., and should



CLUTCH ENGAGED

CLUTCH DISENGAGED

All Osgood excavators of 1 cubic yard capacity and more are provided with air controls for all operations except that of the main engine clutch. Hoisting, crowding, steering, swinging and traveling are performed smoothly and with no physical effort by means of a series of pneumatic clutches of the friction-disk type developed by the company. The unit is known as the Osgood Air-cushion Clutch and is engaged by admitting compressed air into a circular rubber tube or doughnut that is confined between two plates, one of which is movable. Expansion of the tube causes the floating plate to clamp the friction disk between the moving plate and the back plate of the clutch. Metering valves, controlled by a bank of short throw levers in the cab, permit the operator to regulate the pressure or the speed of the various functions. He can pick up the load as slowly or quickly as may be desired because the volume of air required to distend the doughnut and to engage the clutch is such that it is impossible for him to admit it fast enough to jerk the machine. Other advantages claimed for the new clutch are that lever arms, pins, collars, and other small parts are eliminated, and with them the inevitable lost motion through wear. Further, it needs no adjustment as the cushion compensates for disk wear.

prove of considerable value in our research work in powder metallurgy.

Fiberglas in the form of thin porous webs that serve as a carrier for bitumen is being used as a roofing material. It is supplied in rolls each covering 864 square feet of surface and weighing only 9 pounds. The virtues of fiber glass are that it does not rot and that heat does not affect it.

To prove the contention that a slight increase in the diameter of wire rope used with heavy equipment will give the former increased service life, two power shovels were run side by side with skilled operators in the cabs. Both were of the same capacity, sheave diameters were identical, and the cables were made of 6x19 preformed regular-lay improved plow steel. The only difference was that one shovel was provided with 1-inch rope and the other with 1⅛-inch rope. Records show that the latter handled 257,967 tons of material before it failed, while the other moved less than half as much, or 112,184 tons.

Ground has been broken at the California Institute of Technology, Pasadena, Calif., for the $3,000,000 super-

NO STOOPING—NO STRAINING

This little departmental truck has been designed by Easy-Tote Products, Inc., for handling tote pans or other containers with a minimum of effort. Instead of dragging them along the floor to the detriment of both floor and boxes, the worker loads them onto the tilting 16x22-inch base plate by the aid of the crank, hook, and rigid handle. Two roller-bearing side wheels and a full-swiveling caster with antifriction bearings make for easy haulage. Lifting rigid handle causes pans to slide onto the floor. Because of its size, the Easy-Tote, as it is named, can be used in confined areas, as well as to load and unload boxes beneath work benches. It is built to carry 600 pounds with a wide margin of safety.

HOW NAYLOR PIPE OFFERS YOU The Means to Any End

Although Naylor pipe is light-weight pipe, Naylor's wide variety of standard-weight ends enables you to use Naylor pipe with fittings and equipment common to industry. It is possible to change connections quickly from one type to any other as required. By careful selection of the Naylor coupling best-suited to your job, you can save time, work and money.

A section of the Naylor Catalog provides helpful information on the subject of pipe connections. If you have not already received a registered copy of Naylor Catalog, No. 44, it will pay you to write for it today.

Naylor

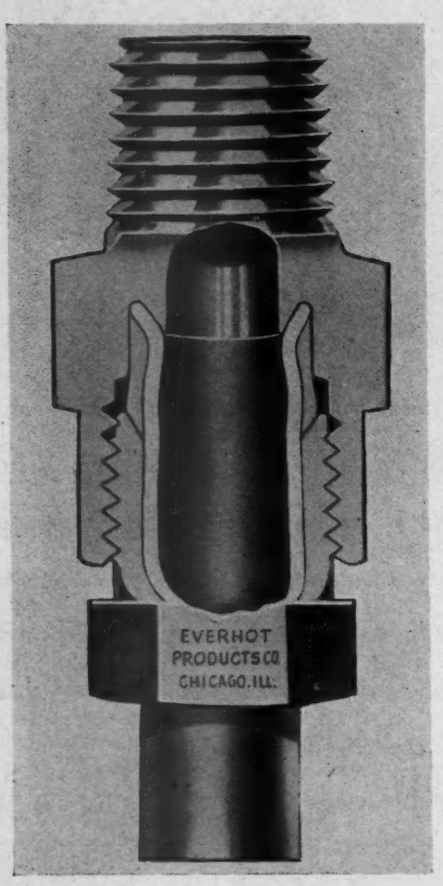
NAYLOR PIPE COMPANY

1245 East 92nd Street • Chicago 19, Illinois

New York Office: 350 Madison Avenue • New York 17, N. Y.

sonic wind tunnel for the testing of rockets, guided missiles, and jet-propelled planes. It will be nearly 150 feet long, about 8 feet wide at the ends, and taper to a 2-foot passage near the center where the models will be suspended and tested at air speeds up to 3000 miles an hour. The plant is being financed by the U. S. Army Ordnance Department and built by the Corps of Engineers. It will be powered by a battery of large centrifugal air compressors operated by electric motors.

Brass tube connector fittings that flare tubes as they are inserted and seal them at the same time have been announced by Everhot Products Company. Consisting of two pieces—fitting and nut—tube is introduced through the nut into the body of the fitting until it rests against an annular seat. Then nut is tightened until its tapered "sleeve" be-



comes wedged between tube and fitting walls and shears off. Wrench action on nut pushes sleeve further, driving tube into a recess in the fitting and forming a 37° flare and seal that is said to be resistant to more than 8600 psi. pressure. Connector is suitable for use with copper, aluminum, monel, steel, and other tubing, and a stock of ten shapes in the various standard sizes takes the place of the multiple assortment of straight connectors, elbows, tees, etc., in each of the different types of fittings now in common use.

"VIC" VICTAULIC SAYS..

"IF YOU'D LIKE INCREASED DELIVE
AT LOWER PUMPING COSTS!

"Look into this winning combination—Victaulic Full-Flow Fittings and Victaulic Couplings! You'll find out about a pipeline that not only increases delivery... it also lowers pumping costs!

"Our Full-Flow FITTINGS are designed with long and easy sweeps... have true-circular, smooth walls that eliminate internal projections and pockets.

"But that's not all! Victaulic COUPLINGS give pipelines *flexibility*... and a *union* at every joint. This positive, slip-proof coupling can't blow off or pull out under pressure, vibration, or sag! Also, the 'two-bolt' simplicity of Victaulic Couplings saves time with quicker installations, saves money with easy sectional repairs and 100% salvageability!"

Why not save yourself both time and money by making your next pipeline *completely* Victaulic... Victaulic Full-Flow Elbows, Tees and other Fittings joined with Victaulic Couplings!

Write for new Victaulic Catalog and Engineering Manual

VICTAULIC COMPANY OF AMERICA
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Victaulic, Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 200 Bay St., Toronto 1
For export outside U. S. and Canada: PIPECO Couplings and Fittings
Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N. Y.

Have you considered Victaulic for your piping requirements?
Sizes—¾" through 60"

SELF-ALIGNING PIPE COUPL
VICTAULI
EFFICIENT FULL-FLOW FITT

Copyright 1947, by Victaulic Co. of America

YS...

ELIVE
OSTS!

lic Full-
find out
very ... it

ith long
alls that

ive pipe-
his posi-
ut under
implicity
installa-
nd 100%

by mak-
Victaulic
ned with

anual
ERICA
, N. Y.
lif.
ronto 1
nd Fittings
0, N. Y.

E COUP
ULI
OW FIT

AIR MAG